THE MICHIGAN ALUMNUS.

SCIENTIFIC AMERICAN

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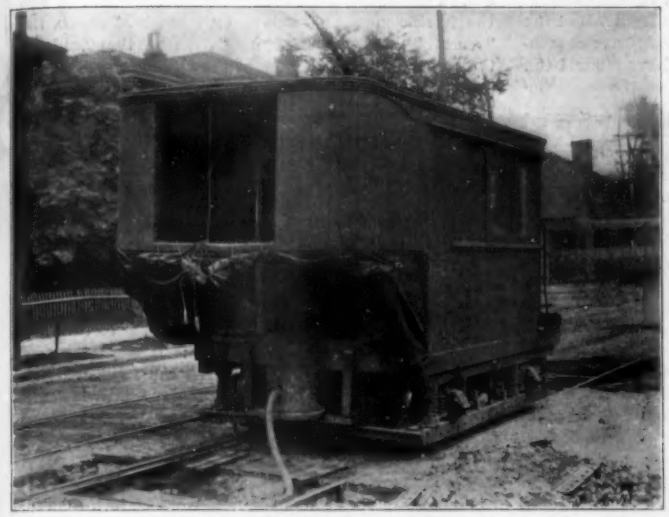
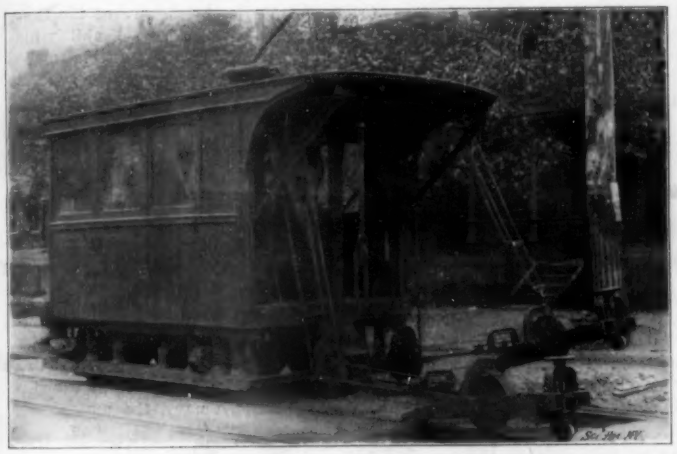
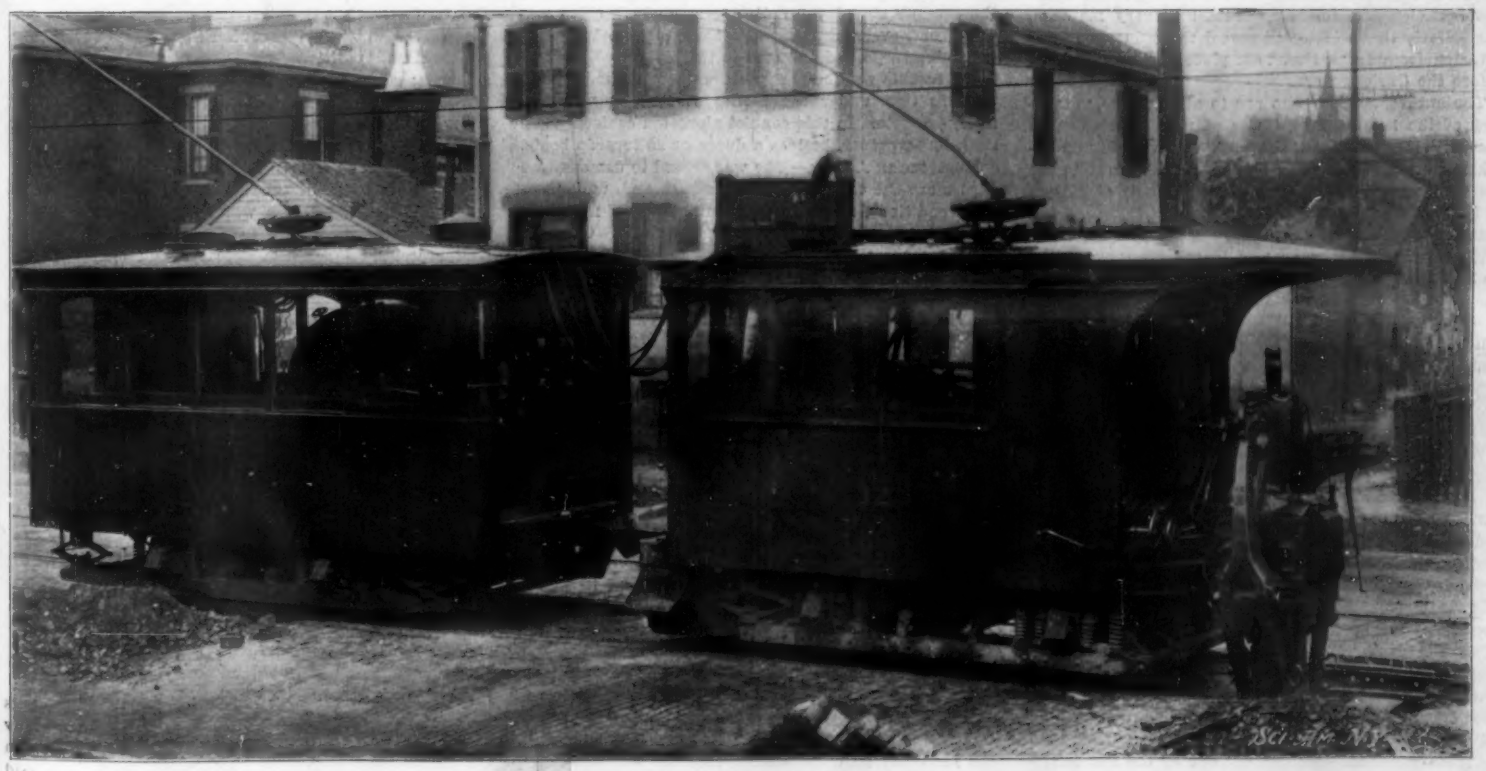


The Sand-Blast Equipment.

The Electric Welder at Work.



Grinding the Finished Joint.



A Welding Train Ready for Work.

TRACK-WELDING BY MEANS OF THE ELECTRIC CURRENT.—[See page 242.]

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NEW YORK, SATURDAY, APRIL 4, 1903.

The editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contributions will receive special attention. Accepted articles will be paid for at regular space rates.

THE BLOOD OF ALL RACES.

Ethnologists of the Smithsonian Institution have investigated the Filipinos, with results that are of rare interest to science. They have called attention to the fact that in the veins of the tribes of the archipelago flows the blood of all the races and varieties of mankind. The Smithsonian Institution is giving special instructions to those intending to explore the caves of the Philippines for crania, and to search for other ethnological data.

In the make-up of the composite Filipino, the darker substratum has been supplied by Negrito, Papuan, and African negro. A copper tint and fighting blood have been furnished by Malay and Polynesian. A lighter hue and certain arts have come from Japanese, Chinese, and Cambodian. Hamite, Semite, and Aryan have stamped their image upon the islanders. Even an ancient stream of Caucasian is traced by ethnologists; and, stranger still, perhaps, the discovery has been made that a rivulet of American Indian blood found its way to the cosmopolitan veins of the Filipino through the channels of two centuries of uninterrupted commerce between Mexico and Peru and the archipelago.

In view of this converging of racial streams in the Filipino, scientists of the American Bureau of Ethnology hope that a detailed investigation of the habits, implements, relics, beliefs, legends, etc., of the various tribes of these islands will be undertaken. In addition to exploration in search of prehistoric crania in caves, the purpose is to make a comprehensive collection of native hammers, saws, adzes, clamps, and every primitive implement representative of stages of invention between the stone age and modern times. It is expected, too, that instruments of prehistoric engineering may be found.

It is known that some of the Filipino tribes are skillful metallurgists, inheriting doubtless from ancient Malay artisans dexterity in fine hand processes. It is hoped by the scientists that additions to one of the most interesting chapters in human history will be made through discoveries in the Philippines of the secrets concerning the ancient arts of working metals. Collections are to be made of the early poetry, tribal proverbs, legends, folklore, and all literary material, particularly that which will reveal the influence of the invasion from India that took place several centuries before the Christian era.

The anthropologists who are to attempt the untangling of the record of centuries of race interfusion in the Philippines realize that they have a very big undertaking on their hands, but this gives added zest to the research. A special request has been made of officers of the United States to assist in collecting everything that may help to throw light on the story of the early savage navigators who cruised in the channels of the archipelago. In answer to inquiries, the United States Treasury Department has assured the scientists about to embark on ethnological work in the Philippines that collections brought back for the Smithsonian Institution will not be subject to duty.

FINAL LESSONS OF THE GERMAN AMERICAN WAR GAME.

With the publication in the current issue of the SUPPLEMENT of the fourteenth of our series of articles on the naval war game between the United States and Germany, we reach the close of this most interesting and instructive struggle. Our readers will, of course, have formed their own conclusions as to the lessons to be learned therefrom; and that the publication of this matter has awakened widespread attention, and has served the useful purpose of instruction as to the relative strength of our own and the German navy, is shown by the large number of letters that have reached this office from all parts of the United States, some of which we have from time to time made public.

PANAMA CANAL.—It will be generally agreed that the most important fact brought out by the war is the great strategical advantage which would have been conferred upon this country by the existence of the Panama Canal. It was because we had no short cut to the Pacific that the Germans, in the early stage of the conflict, were able to concentrate an overwhelming and homogeneous force of battleships at Manila, and practically wipe out the heterogeneous fleet of battleships, monitors, and cruisers which had been hastily assembled for the defense of our naval base in the Far East. In that fight we lost four battleships, two monitors, and four cruisers; and it was only after sufficient time had elapsed for us to concentrate in eastern waters the three battleships of the "Maine" class, together with the "Alabama" and "Kearsarge," that we were able to stem the tide of disaster by winning a signal victory off the German base at Kiao Chau. After our success in the Pacific, there was another long delay, pending the arrival of two battleships of the "Maine" class from the Far East by way of Cape Horn. Had the Panama Canal been in existence, we could have concentrated a force off Havana which would have insured the early destruction of the German fleet in the West Indies; and the victory that was ultimately secured would have been more decisive than it was.

THE SUBMERGED TORPEDO TUBE.—The second lesson of the war is the enormous value of the submerged torpedo tube on battleships and cruisers. The majority of the German vessels engaged were fitted with a submerged tube located on the longitudinal axis of the vessel, at the point below water where the fore-foot rounds up into the ram. The German naval constructors were early to perceive the immense advantage of the submerged torpedo tube and all of their latest ships, both battleships and cruisers, have been so fitted. Our own vessels, unfortunately, did not carry a submerged tube, and the above-water tubes, because of the great risk of the explosion of the torpedoes by the rapid-fire guns of the enemy, had been in many cases removed, leaving our ships with at best only a very limited torpedo armament. This disparity not only seriously hampered the American admirals in the disposition and handling of their vessels, but in some battles it proved the undoing of our fleets. In a cruiser engagement that took place in the Atlantic early in the war, the issue was suddenly decided by a swift movement of the German cruisers, which enabled them to torpedo four of our cruisers in succession, the German boats being able to cross in front of our line at sufficiently close range for using the torpedo, without being themselves exposed to torpedo attack. In the whole war we lost, by torpedoes fired from the warships themselves, no less than eight battleships and cruisers against a loss to the Germans in battleships and cruisers by torpedoes from our own ships, if we exclude the submarines, of only one cruiser.

TORPEDO BOATS AND DESTROYERS.—The torpedo boat, moreover, fully established itself as a most effective element in modern warfare. In the battle off Manila early in the war, after our fleet had been thrown into disorder, the German torpedo boats were sent in to give the final *coup de grace*, which they did by sinking three battleships and two monitors. Then again, in a night action between two approximately equal fleets of cruisers and torpedo boats (in which, because of a similar ruse adopted by each fleet, each group of torpedo boats was enabled to get in among the enemy's ships) the entire force on both sides was wiped out, every cruiser and all the torpedo boats but one being torpedoed and sent to the bottom. Extraordinary as this result appears, it was considered by the umpires that under the tactics adopted it was perfectly possible. In this conflict alone ten cruisers were sunk by torpedoes, besides a dozen or so torpedo boats.

MONITORS IN ACTION.—The war served to demonstrate once more the comparative uselessness and, under certain conditions, the absolute encumbrance of monitors, when they form a part of the line of battle. On more than one occasion the speed gage remained with the Germans because of the obligation that the American admiral was under to keep down the speed of his battleships to that of the slow monitors. This was one of the contributory causes to the defeat at Manila; and although in the last fight of the war, as described in the current issue of the SUPPLEMENT, the monitors proved to be extremely hard to hit, and although their 12-inch guns did frightful execution upon the German battleships, it is a question whether the small target that they afforded was not more than offset by their comparative unhandiness and lack of maneuvering ability. Furthermore, it is a fact that in this battle, while the German line was moving at an uniform speed of 15 knots, our own line, because of the slowness of the monitors, was moving only at a little over 7 knots an hour, or only half as fast.

SUBMARINES.—In the great deciding battle of the war, victory was snatched from the German fleet by the sudden entrance of the submarines into the fight at the very moment when the remaining German ships were closing in, themselves badly disabled and with speed greatly reduced, for the closing stroke. This result will naturally be very pleasing to those who pin their faith to the submarine; but it must be remembered that their effective work was due to most favorable weather conditions, for the day being particularly fine, and the sea smooth, it rendered the successful operation of the submarines possible. Moreover, these same weather conditions were distinctly favorable to the monitors, which, had the sea been rough, could never have concentrated such an effective fire as they did against the German line.

GUNNERY.—Although the American navy was conspicuously weak in torpedo attack, the greatest credit is to be accorded to its gunnery, which proved almost as destructive to the German fleets as the German torpedoes did to our own. To the concentration of fire from our heavy guns is to be attributed the loss of two German cruisers and of six of the finest of the German battleships, in our victorious action off Kiao Chau; and in the successful battle that closed the war, it was the terrific mauling received by three battleships, the "Wettin," "Mecklenburg," and "Woerth," that rendered them easy objects of attack at the close of the battle by our submarines. As far as our own ships are concerned, we lost six cruisers and five monitors, as the direct result of gun fire, the vessels being either sunk, or so completely disabled that they were obliged to strike.

SPEED.—There can be no question that the possession by the Germans of the speed gage in certain of the conflicts of the war was of enormous advantage; and it was only when matters were evened up in this respect, in the battle won by us off Kiao Chau, a victory due largely to the good speed of the "Maine," "Missouri," and "Ohio," that we were able to turn the tables and maneuver to good effect. If the lessons of the war teach anything, they teach the folly of building battleships or cruisers whose speed is below the average speed of any possible enemy. Eighteen knots should be the lowest contemplated speed of our future battleships; and it is quite a question whether it will not prove to be an advantage to sacrifice some weight of gun fire for the sake of an additional knot of speed. The admirals on both sides seem to have aimed at placing their line of battle in a position which would enable them to concentrate the whole fire of the fleet on the head or tail of the enemy's line, disabling his ships in detail; and such a feat is only possible to the fleet which has a higher average speed and general greater mobility.

ENORMOUS PERCENTAGE OF LOSSES.—Perhaps, after all, the most striking fact brought out by this war game is the frightful diminution of naval strength and international standing which will occur in both of the navies engaged. Out of a total of 49 ships engaged, Germany lost about a score, in which were included the very finest of her battleships; while out of the total of 53 vessels engaged on the American side, we lost no less than 29. While our loss was numerically greater, we did not lose so large a number of our best ships. The exhausted condition of the combatants at the close of the war is shown by the fact that, although the umpires decided that the advantage lay with the American navy, the mutual destruction had been so terrific that the German navy had but one effective battleship left and the United States but two; that is to say, there were in the combined fleets but three first-class battleships left at the close of the war, that were in condition to carry on the conflict. Consequently, two of the first-class navies of the world were reduced in a few months to a second-class position as regards their fighting strength; and since the work of battleship building is slow, it would take at least four or five years to bring these navies up to their strength at the opening of the war, and probably twice that length of time to restore them to their relative standing among the other great navies of the world.

Here is a consideration which we think must make very strongly for peace in all future international controversies. When the defeat of an enemy is attained at such a frightful cost and at such peril to international ranking, we look to see the very last resources of diplomacy exhausted before any war takes place between the leading powers.

VERTICAL TRANSPORTATION.

In considering recently the general subject of transportation, attention was called to the congested conditions of travel in a crowded city like New York, and especially to the fact that much of the discomfort arising therefrom is due to the immense increase in population within restricted areas, both in the residential and business portions of the city, which render the congestion at certain hours of the day so serious as to render travel in the city a struggle not always unattended with personal danger. This increase of population is due to the growth of our cities in a vertical sense—in the residential part of the city, by the erection of "flat" or apartment houses, a score of stories high, and in the business district by office buildings which have a height so great as to engulf in many cases even the steeples of neighboring churches. In the primitive town the one and only street was laid out horizontally. In the modern city the streets are often vertical. In a modern community like the Park

Row building in New York there are over six thousand inhabitants, with a vertical thoroughfare having twenty-five cross streets.

There are about a thousand offices in this building, with the top landing 294 feet from the ground floor. To provide transportation for these people, we find an equipment of ten elevators, each capable of carrying sixteen men, and making the trip to the top floor and back in three minutes. At this rate two hundred round trips a day are made by each elevator during business hours. On an average one need never wait more than eighteen seconds for a car, and a man at the top floor can reach the street in two minutes at the most. Each car averages sixteen passengers per round trip, and travels a distance of twenty-two miles a day. This means a total of 220 miles a day traveled by the cars altogether, or a distance stretching from New York to Washington. The elevator schedule in the Park Row building, as first arranged, provided for the running of five express cars and five locals. However, it was found that better time could be made even from the top floors when the cars were all run as locals, because since twice as many cars were thrown open to all the floors, the number of passengers taken on and off at each stop was decreased, and the saving thus occasioned more than overbalanced the time consumed by the slight increase in the number of stops.

A notable example of the use of express elevators may be found in the Broad Exchange building, New York city. In this building there are 1,400 offices, and eighteen elevators are provided for the transportation of the seven or eight thousand occupants. Half of these elevators make no stop between the first and eleventh floors, and the other half travel no higher than the eleventh floor. This arrangement affords greater economy of space, because, instead of continuing the elevator shafts of local cars up to the top of the building, the space from the twelfth floor up is employed for other valuable purposes.

From the foregoing it will be seen that while, as previously stated, the vertical growth of our cities was made possible by the use of steel in building construction, no such development would have resulted without the introduction of elevators to make tall buildings profitable.

Public attention was first directed to the advantages of elevators at the time of the New York World's Fair in 1853, when Mr. E. G. Otis gave an exhibition of his patent safety device in the Crystal Palace. A great impression was made on the spectators when the inventor, after running his car to the top of the shaft, cut the supporting ropes and descended safely to the main floor. The next year Mr. Otis secured a bit of land at Yonkers on the Hudson, and began the business of manufacturing elevators. It was not until 1859 that the first independent elevator engine was built, and a dozen more years passed before the hydraulic elevator was developed. Since that time we have had one more important innovation, that of the electric elevator, which was first introduced to the public in 1888. At present there are five distinct types of hydraulic elevators. Of these, the vertical cylinder type is the oldest and most common. Another type which differs from this only in the position of the cylinder is the horizontal cylinder type, which is found useful where space in the shaft is more valuable than that in the basement. In these two types a pressure of 150 pounds to the square inch is commonly maintained. Where it is necessary to have the elevators scattered about in various parts of the building, the high-pressure inverted-cylinder type is most useful. The power which is developed in one portion of the building can, by this means, be more widely distributed, and the machinery may also be made more compact. Two other types, the pulling plunger and direct lift, complete the list of hydraulic elevators. In the pulling plunger type no counterweight is used, but the plunger is made heavy enough to raise the car by its own weight, while hydraulic pressure is exerted to lift the plunger when the car is descending. In the direct-lift elevator the cylinder and piston are situated in a shaft sunk into the ground a distance equal to the desired travel of the car. This type is commonly used for freight, though it makes an excellent elevator for passenger service as well where conditions permit, because no energy is lost in the transmission of power, but the piston acts directly on the car.

In electric elevators the driving means of course is an electric motor, which operates a winding drum through suitable gearing, but the most important feature of the electric elevator is the device for starting the motor. Of course, it would not do to provide a starting box on the car, for the careless operator would be too apt to suddenly turn on the entire current and burn out the motor. On this account automatic devices for gradually cutting out the resistance are provided. The operator has no control over the action of this device except to start, stop, and reverse the same.

Although a great many improvements have been made in the motor mechanisms of elevators, the safety device now commonly used does not differ materially from that which proved its worth thirty years ago, such changes as have been made being principally due to increased speed of travel and heavier loads now carried. When we stop to consider that more rides are taken daily on elevators than in the street cars of our cities, the safety of these conveyances may be appreciated. Accidents on elevators occur so rarely that the daily papers usually accord them the prominence of a front-page article with a glaring title.

A type of electric elevator which is coming into great prominence is the automatic elevator for private residences. This is operated by a set of push buttons, and requires no elevator man. If someone on the second floor desires to go up to the fifth, he first presses a button that brings the car, if idle, up to his landing. As soon as the car comes to a stop, and not before, the door at the landing is automatically unlocked, so that the person can open it and enter the car. The door must then be closed before the car may start up again. A button marked "Fifth Floor" is now pressed, and the car is started up automatically, stopping when the fifth floor is reached. While in motion the car throws out of circuit the buttons of all the floors except that to which it is destined, thus preventing interruption until the trip has been completed.

In closing we must not neglect to mention the escalators or moving stairways, which are growing in prominence as a means for carrying large crowds for short distances. This type of elevating device gives promise of a great future, and should prove an important factor in our progress toward the city of theoretically perfect development.

THE BRITISH BATTLESHIP CONSTRUCTION PROGRAMME FOR 1903.

BY OUR LONDON CORRESPONDENT.

Owing to the exceptional activity being displayed by the various great powers and the augmentation of their respective navies by the embarkation upon elaborate naval programmes, the Admiralty scheme of Great Britain for the present year is very extensive, in order to maintain the necessary superiority of the English navy, and to preserve the balance of power. The 1903 programme provides for the construction of forty-two new vessels of all descriptions, comprised as follows:

Battleships	3
First-class armored cruisers	4
Third-class cruisers	3
Scouts	4
Destroyers	15
Submarines	10
Coastguard cruisers	2
River gunboat	1
Total	42

The total cost of these new vessels amounts to $50,682,150, which is an excess over the sum similarly devoted to the 1902 building programme of $5,389,550, while the total sum to be expended upon the navy during the present year is $172,287,500, an increase of $16,010,000 upon the previous year.

In addition to the foregoing new vessels, which are to be laid down at once, the following ships are now in course of construction:

Battleships	11
Armored cruisers	19
Second-class cruisers	2
Third-class cruisers	4
Scouts	4
Sloops	2
Destroyers	19
Torpedo boats	8
Submarines	3
Total	72

And of these, six battleships, eleven armored cruisers, and the majority of the other vessels will be in commission before April 1, 1904. During the past year the British navy has been increased by the addition of 4 first-class battleships, 5 armored cruisers, 2 sloops, 4 destroyers, 3 torpedo boats, 6 submarines and one or two other minor vessels.

The imperative and vital necessity of rapid construction is fully realized by the Admiralty, and in order that the vessels in the new programme may be constructed without any delay, such as necessarily arises in the government dockyards, all the vessels in the 1903 scheme, with one exception, will be built in private shipyards. In order that the new vessels may be turned out by the contractors completely equipped and ready for service, and in view of the up-to-date equipment of the private shipyards, the contractors will be required to complete the ships in all respects ready for commission, i. e., not only build the hull of the vessel, but supply the armament as well.

The estimates do not afford any indication concerning the design of any of the new ships, but it is generally understood that the battleships will possess the further improvements in respect of gun power on the "King Edward VII." class outlined in a recent issue of this journal, and that they will cost approximately $7,000,000 each. The construction of the ten submarines is to be hurried forward as quickly as possible. In their design they will embody several improvements, especially in the system of propulsion, the gasoline engines which in the existing craft have proved unreliable and generally unsatisfactory being superseded by improved propelling machinery. During the year $16,500,000 is to be spent on armaments, as follows: Seven 12-inch 50-ton guns, 23 of 9.2-inch caliber, 60 6-inch quick firers, and 159 smaller guns; but there will also be completed, including guns already ordered, 12 12-inch 50-ton guns, 11 of 9.2-inch caliber, 10 of 7.5-inch, 136 of 6-inch caliber, and 224 smaller weapons.

Concerning the royal naval reserve of merchant cruisers, the list is practically the same as before, consisting of the three White Star boats, "Oceanic," "Majestic," and "Teutonic"; three Cunarders, "Campania," "Lucania," and "Umbria"; four P. and O.'s, two Orient liners, two Royal Mail boats, the Pacific liner "Ortona," and the three Empresses of the Pacific. For these vessels a subsidy of $389,065 is to be paid. In addition to the above list there are 31 steamers belonging to these respective companies held at the disposition of the Admiralty without further subsidy.

The Admiralty have not lost sight of the applicability of liquid fuel to battleships, and experiments are being carried out upon the new turbine torpedo-boat destroyer "Velox" and upon two battleships. Great difficulty is being experienced in adapting liquid fuel to war vessels, since oil fuel is of no advantage to the navy, as compared with Welsh steam coal, unless the combination can be brought to such perfection as to render the fuel practically smokeless.

One of the most important new departures in the administration of the navy is the appointment of a small committee composed of the highest recognized authorities on marine engineering in the country, to be at the disposal, when required, of the controller of the navy, so that the Admiralty board may profit by any advice or suggestions that may be proffered relative to any questions concerning vessels.

Furthermore, a new squadron is to be created—the South Atlantic squadron—which will serve the southeast coast of America and the west coast of Africa, and use Gibraltar and Sierra Leone as its bases.

VULCANIZED TIMBER IN ENGLAND.

A considerable amount of interest has been aroused by the announcement, as the result of a prolonged series of experiments, of a method of so treating timber as to secure even from soft wood a largely increased toughness and hardness. The process is described as one of vulcanizing, comparable in some respects with Bessemer's process of converting iron into steel, and is the invention of Mr. Powell, a Liverpool merchant. The treatment to which the timber is subjected is, roughly speaking, that of saturation at boiling point with a solution of sugar, the water being afterward evaporated at a high temperature. The result is to leave the pores and interstices of the wood filled in with solid matter, and the timber vulcanized, preserved, and seasoned. The nature of moderately soft wood, it is claimed, is in this way changed to a tough and hard substance, without brittleness, and also without any tendency to split or crack. It is also rendered remarkably impervious to water. Hard wood similarly treated derives similar benefits. Moreover, it is claimed that the process may be completed and timber turned out ready for use in a few days.

"CALLITYPY."

Most of our readers will probably remember the discussion carried on in our correspondence columns on the possibility of using the ordinary typewriter for the purpose of making a matrix to cast printing types. Some of the critics of this plan contended that it would be impossible to bring the ends of the lines in absolute vertical alignment and that, furthermore, the difficulty of making corrections was insuperable. In the current SUPPLEMENT will be found an article by Jacob Backes on "callitypy," a new printing system, in which it is explained how the ends of the lines may be brought to register. In carrying out the system described, the printing plant used consisting of one or more writing machines of any standard make, sheets of white paper, a square, a ruler, firm white cardboard are the only utensils required. It is true that callitypy is to be used primarily for the purpose of making line engravings of typewritten matter as a substitute for direct printing without recourse to typesetting or line-casting. Nevertheless, the system shows that it is at least possible to overcome some of the objections which have been advanced to the use of the typewriter as a means of making the matrix for the casting of type.

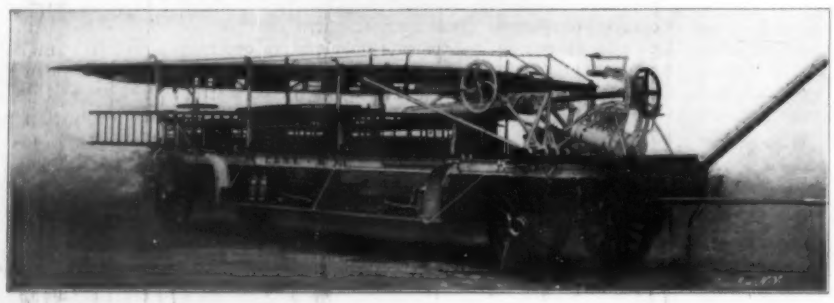
SOME MODERN APPLIANCES FOR LIFE SAVING AT FIRES.

The most progressive American fire departments have of late given great attention to the subject of saving human life at fires. The size and height of modern buildings and the inadequacy of many systems of stationary fire escapes, despite the notable improvements of the past few years, have rendered well nigh imperative the provision of better facilities for the rescue of persons who in the event of a fire find their escape from the upper stories of buildings cut off by smoke and flames; but it is no exaggeration to say that the accomplishments in this direction have far exceeded anything that might be expected in the rather brief interval which has sufficed for the evolution.

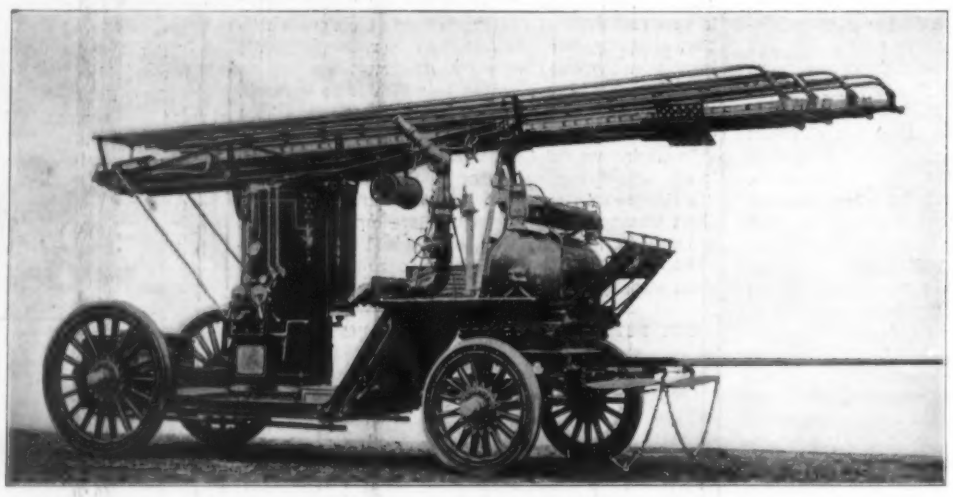
The proverbial courage, energy, and agility of the typical American fireman have assuredly proven an important factor in the development of the present degree of efficiency in life saving at fires; but a very large share of the credit must also be accorded to the ingenious devices, most of them of recent invention, which constitute the working equipment of the present-day life-saving fireman. Of what marvelous celerity of action the firemen life-savers of the United States are now capable was strikingly attested at the Paris Fire Congress of 1900, when a life-saving crew of American firemen were conveyed a distance of a quarter of a mile, scaled a temporary seven-story building by means of ladders, made fast life-lines, and rescued one person from the seventh story and two persons from the sixth story in the total elapsed time of three minutes and forty-two seconds. The speediest foreign crew that essayed to compete with them required over ten minutes to perform the same task.

Of the means and methods of saving life at fires, perhaps the most interesting are those upon which reliance must of necessity be placed when prompt action is necessary and the character of the apparatus at hand is limited. Prominent among the appliances in use in this branch of the field is the life-net. The approved type of net is circular in form and about thirty feet in diameter. It is suspended from a rim of steel, the net being attached by springs which take up the force of impact of a falling body. At a recent apartment house fire in New York city, twenty-five persons jumped without injury into one of these nets, which was supported by eighteen men. Of the number rescued, fifteen jumped from the third story, while the others leaped from the fourth, fifth, and sixth stories of the burning building.

A utensil upon which the scientific fire-fighter places great reliance when called upon to save human life at fires is the scaling ladder, or "pompier" as it is called. This consists of a 15-foot length of narrow and very tough hickory, with a two-foot steel hook on one end and stout hickory crossbars at intervals of a foot throughout the length of the ladder. The hook, it may be explained, is armed with sharp teeth.



An Aerial Truck.



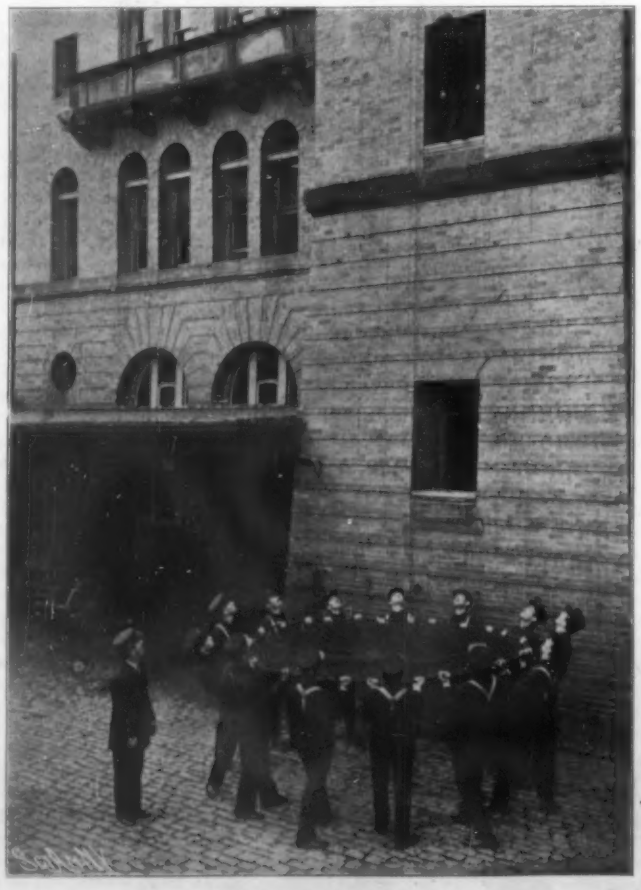
A Pneumatic Extension Ladder.

By the use of a pompier, a fireman may rapidly scale the face of any building, without regard to height, ascending story by story. The spike-like projection at the end of the ladder is thrust through a window-sash, and the hook gives it a firm grip on the window ledge. When the ladder has been secured in this position, the fireman rapidly ascends the cross-pieces or rungs, and taking a position on the window ledge occupied by the hook, is ready to draw the ladder up after him, and in turn hook it upon a window-sash of the story above. This operation is repeated until the roof or any desired floor is reached.

To the uninitiated the mode of operation of the pompier might appear to constitute a rather slow process, but in reality marvelous speed may be attained by men experienced in the use of these scaling ladders. Indeed, it is accounted only an ordinary accomplishment for a fireman to climb to the top of a five or six story building in less than three minutes by the use of these ladders. Under stress of circumstances an athletic fireman can carry to the ground an unconscious or injured person, using but a single scaling ladder, and descending story by story, but the work is greatly facilitated where several firemen work in conjunction and are provided with a supply of pompiers sufficient to form a sort of chain of ladders from ground to roof.

The life-line constitutes one of the most valuable features of the equipment for saving persons imprisoned in a burning building. One end is usually carried to the roof by a fireman using a pompier, but if ladders are burned or other exigencies are presented, a life-line gun is sometimes employed to hurl the rope, in the same manner that life-saving crews on the coasts convey a line to a stranded vessel when the sea running will not permit the launching of a boat. The gun employed in fire-fighting work is of a design similar to an ordinary cavalry carbine, but of much heavier construction, the stock being of solid steel. Over the muzzle is fitted a steel cap, to which is attached the strong light line. The main portion of the line is kept carefully coiled in a tin dish with a center core, and when the gun is discharged the cap flies over the top of the burning building, and the line is paid out as rapidly as needed. By means of the light line the heavier life-line is drawn into place on the roof, and attached to a chimney or otherwise securely fastened.

When descending by means of a life-line, a fireman wears a broad webbed belt attached to which is a large steel hook or snap, and around which two or three hitches of the rope are taken. The fireman may, by grasping the rope with his right hand and the hook with his left, descend at any speed desired, and if desired he can carry down a rescued person. However, where the person rescued is unconscious and unable to render the slightest assistance to the fire-fighter, it is customary to follow a somewhat different plan. In such cases the fireman remains on the roof and places the rope about the form of the unconscious man, so that it constitutes a cradle from which it is impossible for him to slip. The man, who has perhaps been overcome by smoke, is thus lowered in safety to the ground, and the operation is repeated until all the imperiled occupants of the building are



A Jump Into the Life Net.

Rescuing by Means of the Pompier Ladder.

APPLIANCES FOR SAVING LIFE AT FIRES.

rescued, after which the firemen descend in the manner above outlined.

No other class of fire-fighting apparatus has during recent years undergone such marked improvement as the aerial ladders, which are designed, of course, primarily for use in rescuing the occupants of burning buildings. The ordinary trucks, which formerly carried only plain ladders up to 40 feet in length, are now, as a rule, equipped in addition with 50-foot and 65-foot extension ladders; and the extension ladders, operated by means of cranks, are now made in all sizes up to 90 feet, which renders them capable of reaching to the sixth story of an ordinary building. By means of 85-foot aerial trucks of this pattern, men have reached the seventh story of a building in a space of forty-two seconds. Many minor improvements have lately been made in these ladders, including the introduction of the new shoe irons, which prevent the slipping of the ladder, and permanent dowels on the inside of the shoe irons, which add to the stability of the ladder.

For life-saving purposes, however, there is nothing to compare with the new telescopic aerial ladders which are operated by means of compressed air. When it is desired to effect a rescue of a person on the roof or on one of the upper floors of a blazing building, the pneumatic ladder is shot into the air to a point just opposite where the imperiled person is standing, the endangered individual steps on to the top round, and the ladder as suddenly collapses, the tubes telescoping gradually but rapidly, and conveying the rescued person to a point near the ground.

The average telescopic aerial ladder is operated under an air pressure of 300 pounds to the square inch, the air tank being located in the center of the truck carrying the ladder. On many ladders there is provided an auxiliary tank with air under 100 pounds pressure, which is used to supply power for swinging the ladder from one side of the street to the other, so that buildings on both sides of a thoroughfare may be served without serious delay. The truck carrying the ladder weighs about two tons, the heavy construction having been introduced in order to obviate any possibility of overbalancing. Ladders of this pattern of 85 feet extension have been raised to their full height in 25 seconds. Inasmuch as the apparatus is strong enough to carry a dozen men, it is possible to conduct rescuing operations with great rapidity.

REMARKABLE DIVERSION OF NIAGARA'S WATERS.

BY ORRIN E. DUNLAP.

Despite any fancied or real danger that threatens the cataract of Niagara, it is certain that it will take many long years of earnest activity to bring the spectacle to the ignoble condition in which the people of Niagara Falls found it on the morning of Sunday, March 22. Late Saturday afternoon or evening the ice came down the upper river from Lake Erie in marvelous quantities. The floe was so heavy that immense fields of it lodged on the rocks and reefs above Goat Island, the result being that practically all of the water that would find its way to the lower river over the American Fall and precipice was diverted to the outer or Canadian channel. This left the riverbed of the American channel, between the mainland and Goat Island, high and dry, and on Sunday great numbers of people visited the scene and walked about the river-bed.

The condition was surprising. Those who have passed all their days at Niagara were amazed that such a thing was possible. Under normal conditions the channel between the mainland and Goat Island is a scene of furiously tossing water that leaps and bounds, tumbles and rolls, over reef after reef in its impetuous rush toward the awful precipice. In this channel the water speeds on at a rate of from fifteen to twenty miles an hour, and in places is twelve feet deep. But on the Sunday referred to, the rocks of the riverbed formed a glorious searching place for the relic and souvenir hunters, who marveled at the wonderful condition wrought by the gathered ice a short distance up stream. It is recorded in the historical annals of Niagara that a similar incident occurred on March 29, 1848, but people who have lived at the Falls ever since then have no recollection of such a diversion of the waters as that of March 22 last. Situated between the mainland and Goat Island nestles pretty Green Island, and it was from this island that the dry rocks were most easily reached by the crowd of pedestrians. Under normal conditions of the river, Green Island is situated in the midst of the turbulent flow, and on each side of it the water rushes in good volume at rapid speed. When the waters were diverted, however, it was possible to walk from Green Island right up the river-bed to the head of Goat Island, but in order to do this, reef after reef had to be climbed. The temporary diversion of the torrent gave fine opportunity for an inspection of the river-bed and the rock formation that causes the beautiful rapids so much admired by visitors, who stand a long time on the island bridges and watch the flood come down from the sky, as it were.

With the water diverted, the fall of the riverbed seemed more pronounced than ever before. To stand down close by the bridges built from the mainland to Goat Island and look up stream was a remarkable sight. It was like looking up a hill of rocky shelves of stairs, and it was almost impossible to con-

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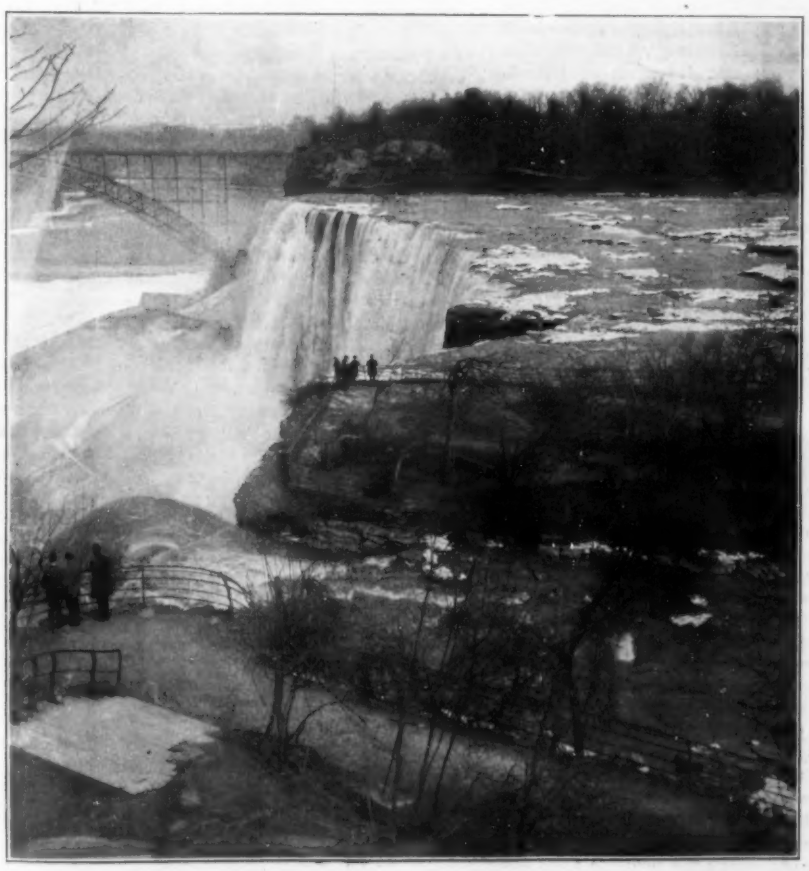
The American Channel Looking Toward the Mainland from Goat Island. The People in the Distance are Walking up the Riverbed at Midstream, where the Rapids Usually Toss with Great Fury.



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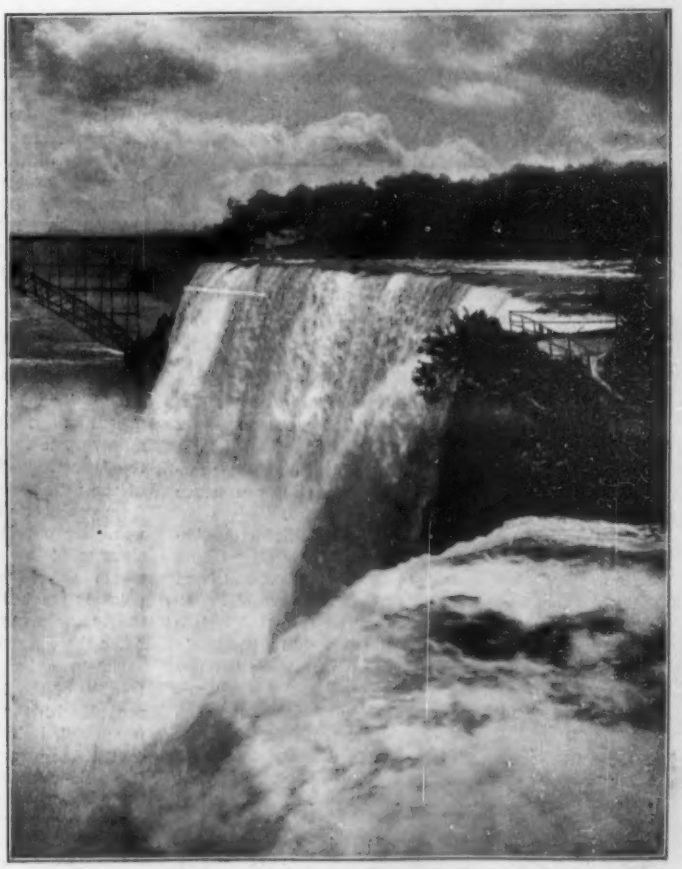
The American Falls on March 22, 1903, when the Waters of the River were Diverted.



The American Falls at the Normal Flow of the River.

THE REMARKABLE DIVERSION OF THE WATERS OF NIAGARA.

ceive that only a few hours before a large portion of the waters of Lake Erie had taken this route to old Ontario and that in all likelihood they would be flowing over the same route within a few hours more. Here and there was a gravelly-like deposit that had been brought down from above by the stream at full flow, but left behind on the rocks as the vigor of the river gave out. Great patches of ice were left all about on the rocks, as the water became too low to float them. Big pieces of loose limestone rock were deposited in some places, but for the main part the river's course was over the limestone ledge that had been swept quite clean by the rushing river.

At no time in the history of Niagara were so many souvenirs taken from the river in a single day. Well-worn stones, rough rocks, small trees and canes from the little islands, Ship and Brig, all served the purpose of souvenirs, while in some cases people carried off shrubs torn up by the roots from the little islands they had never before visited. The pot holes, the crevices, all depressions were searched by the eager crowd, which was made up of men, women and children, all unmindful of the fact that the river might any moment burst through the ice jam and sweep them over the fall to eternity.

When supported by the customary downpour of water from the great reservoir above, the American Fall of Niagara is without doubt a magnificent spectacle; but when the waters cease to flow, when the plunging, reckless torrent is diverted in its volume, as on March 22, the grandeur disappears, and the world's greatest waterfall is a shame-faced spectacle that would make one of the many poets who have told of its sublimity sorry he had ever looked upon it and become enthused over its magnificence. Usually, a powerful stream of water rushes through between Goat and Luna Islands, for it is under this Center Fall that the Cave of the Winds has its glory; but on the occasion of the ice jam the stream at this point was unworthy of the name creek, so weak was its flow. For centuries the water has burst over the edge of the precipice of the American Fall in a gleeful way, shooting far out with a bound and a jump, forced on by the pressure of the flood behind. The picture reproduced shows barely enough water coming down to the brink to curtain the rocky cliffs from the view of the curious thousands who came to see Niagara and its force conquered. The huge ice mounds in front of the fall stood out naked, while the rocky talus at the base of the fall was also partly in full view, telling only too plainly why it is the bodies of so few persons who go over this fall are recovered.

As wonderful as it was, it is certain that if the time ever comes when the flow of the Niagara River is diverted for any purpose to such an extent as to make such a spectacle as that of March 22 continuous, there will be sorrow at Niagara. And yet Lord Kelvin, the eminent English scientist, personally stated to the writer:

"I look forward to the time when the whole water from Lake Erie will find its way to the lower level of Lake Ontario through machinery, doing more good for the world than that great benefit which we now possess in the contemplation of the splendid scene which we have presented before us at the present time by the waterfall of Niagara."

ELECTRIC TRACK WELDING.

BY WALDON FAWCETT.

Marked improvements have been made during the past two years in the process of electrically welding rail joints. Although by the process which has been used since 1897 the breakage on all welding did not exceed one per cent, the new system has reduced the percentage of breakage to less than one-tenth of one per cent. In the city of Rochester, N. Y., where the new process was rarely employed, more than 5,300 joints were welded during the latter part of 1901. An examination in the spring of 1902 disclosed only six broken rails. None of the damaged rails had a joint broken through the bars or a weld pulled off; practically all of the breaks occurred through the existence of old bolt or bond holes beyond the bars.

The new plan of welding has been still further improved to meet such exigencies, and now all welding bars are made long enough to reach over bolt and bond holes, so that in the future even this source of breakage will be practically eliminated. The remarkable state of perfection to which electric track welding has lately been brought appears all the more marvelous in view of the fact that in the latest approved method employed, each weld depends on the judgment of the man making it, and must necessarily remain in the track and await the strain of winter to disclose defects, if any exist. Even under these circumstances, however, not one weld in a thousand fails to successfully stand the actual test.

The machinery employed in electric track welding—and it is of a very ingenious character—is mounted on trolley cars of special design, the running gear of which is provided with threaded axles, so that the machines can be used to weld track of almost any gage. The welding of newly-laid rails is done either before or after the paving is in place, space being left at the joints to permit the entrance of the welder. When welding is to be done on rails which have been in place for some time, the paving is torn up around each joint, and the old plates and bond wires removed. It is necessary, of course, in such instances, to bring the rail ends up to the proper grade.

The new method of electrical welding comprises three distinct operations. The first step is that of sand-blasting, whereby all the dirt, rust, and foreign matter is removed from the rails, at points where welds are to be made, and also from the bars used in making the joint. Sand-blasting necessitates the employment of apparatus, including a ten horse power motor driving an air compressor, an air storage tank, a sand bin and sand mixer. A hose and nozzle enables the operator to direct the blast of air, carrying the sand against the rails, so that all foreign matter is quickly removed.

Two cars are required to carry the apparatus for welding, which constitutes the second step in the work. The welder itself is hung from a bail on a crane, extending out beyond the end of one car. This crane is so arranged that the jaws of the welder can engage the sides of the rail, and also shift from one side to the other, thus enabling work to be carried out on both rails of the track. The operation of this crane is accomplished by means of friction clutches, from a shaft in the car, which shaft is kept running continuously by a five horse power motor.

The motor also drives a small rotary pump, which circulates water through the welding transformer and the faces of the contacts, thereby keeping them cool. The water, after it has passed through the welder, is elevated to a cooling tank on top of the car. It is of course desirable that this water shall be cooled just as rapidly as possible, for which purpose a novel plan is employed. Starting from the middle of the tank, and passing around and around until the outer circumference of the tank is reached, is a serpentine partition. A perforated false bottom is provided, through which air is forced from a powerful blower. The hot water from the welder passes into the outer portion of the serpentine partition, and is subjected constantly to the modifying influences of the forced air. After reaching the center of the serpentine partition, the cooled water is conducted to one of the tanks in the car.

The welding apparatus proper consists of an alternating current transformer, the primary winding of which is made up of two coils in parallel, each of forty-four turns. A single loop of copper of large cross section forms the secondary coil; and the terminals constitute the contacts or jaws, which engage each side of the rail, and between which the weld is made. Supporting the transformer on either side, although insulated from it, are large levers hinged together at about two-thirds of the distance from the top, which levers are used to transmit the necessary pressure to the weld. A hydraulic jack connects these levers at the top. A pressure of over two tons per square inch is obtained on the rams of the jack, which are less than four-inch diameter; and inasmuch as this is increased by the leverage of the arms, the pressure developed at the weld is in excess of thirty-seven tons.

For making a joint there are employed flat-rolled steel bars which have on one side, at either end, bosses or projections, serving as contact points between the bars and the web of the rail, and confining the welded area of these sections. About the middle of the bars on the same side with the projections is placed a flat strip of steel, perhaps one-eighth of an inch in thickness and one inch wide. The bars are supported on small blocks, and so placed across the joint that the middle strip engages the web of both rails. The end welds are horizontal, while the middle weld is vertical and the full width of the bar.

The whole operation of welding is conducted very expeditiously. When the welding train of two cars is moved up to a joint, the welder is swung into place and the jaws made to press against the bars on each side of the rail. The current is then turned on and flows from contact to contact through the bars and the rail web. By altering the pressure on the jaws, the resistance of the several junctures is increased, and the whole is soon brought up to a welding heat. When this point is reached the current is cut off, and simultaneously the pressure is brought up to the full amount. After the pressure is loosened, the welder car is moved back, in order to bring the jaws opposite the extremity of the bars, and here the same process is repeated, with the addition that when the final pressure is applied, it is held there and the weld permitted to cool under pressure, until no glow is apparent. Then the welder is moved forward to the other end of the bar, and the process is repeated, after which the welder is swung to the opposite side of the car and the joint on the other side is welded.

The present plan of holding the pressure after the completion of the weld increases the strength of the weld very materially. Only the ends are so treated, the center weld being subjected to so slight a strain that such a precaution is unnecessary. One of the improved processes of the new plan of welding grows out of the discovery that it is advantageous to weld the ends of the bars while the bars are in an expanded state. By making the center weld first, and not stopping to cool it under pressure, the greatest elongation of the bars is, of course, secured. As the bars cool off, after the ends are welded, they shrink and exert a powerful pull to bring together the abutting rail ends, thus closing the slightest opening and leaving practically no joint whatever.

The advance in this direction is of greater significance than might at first be imagined, for in the manufacture of a continuous rail, the abutting rail ends, if not brought firmly together, give the metal in the head of the rail an opportunity to flow into the opening between the rails. This will in time cause a low spot in the head of the rail. The bars being always in a state of tension, the rail inclosed between the bars is necessarily in a state of compression; and inasmuch as any contraction of the rail between the joints will be transmitted to the end welds, it is obviously necessary that these latter be as tough as possible, that they may withstand the strain. The center weld merely contributes to vertical stiffness, and tends to prevent any movement of the rail ends.

The current actually used in welding operations by this new plan approximates from 25,000 to 30,000 amperes at 7 volts. The car accompanying the welder carries a rotary converter for changing the direct current from the trolley to an alternating current. The current in the primary coils of the welder is a 40-cycle alternating, at 300 volts; and the direct-current side of the rotary converter is capable of taking from the trolley, current at from 325 to 600 volts. By means of the regulating apparatus, a constant supply to the welder of 300 volts is maintained, regardless of fluctuations on the line. At a voltage of 500, about 225 amperes is required on a line, or, in other words, about 125 kilowatts is required to make a weld, the time consumed, or rather the interval during which the current is on, being two and a half minutes.

The final operation of welding consists in grinding the head of the rail to a true surface. There is comparatively little need for this finishing process where new rails are being welded, but in old track it is very essential, inasmuch as the receiving rail is purposely welded higher than the other. The grinder, which is used to grind out the inequalities in the rail head and bring it back to a true surface, consists of an emery wheel mounted on a carriage having two rollers which are about four feet apart. The carriage is let down on the rail, so that the rollers roll along the head of the rail, and the emery wheel is thus over the uneven portion at the joint. A swing frame connects this carriage with a motor on the car, and the operator is thus enabled to move the emery wheel back and forth over the joint while the car remains stationary. A hand wheel enables the emery wheel to be gradually fed down, and as it is moved forward and back the high places are ground off until the whole joint is brought to a true surface. In many respects the operation corresponds to the manipulation of the ordinary carpenter's plane. When carried on as a continuous process, only about fifteen minutes are required to complete a joint; and when operations are conducted day and night, at least eighty joints are completed in 24 hours.

The Current Supplement.

The current SUPPLEMENT, No. 1422, opens with an article on the recent collision on Long Island Sound, in which the two great Sound steamers, "Plymouth" and "City of Taunton," suffered no little damage. Two splendid pictures of the steamers after the accident are presented. The industry of compressed and liquefied gases is made the subject of a review of some length. Jacob Backes describes a new printing system, whereby it is possible to use ordinary typewriting in lieu of printing types. Sir William J. Herschel's presidential address before the Photographic Convention of the United Kingdom was devoted to a discussion of color photography. Among the shorter articles are those on the osmium electric lamp, monorail lines, steam trucks for heavy hauling, and radio-activity of ordinary metals. Prof. Thurston of Cornell University discusses steam turbines to date. Fred. T. Jane concludes his naval war game articles. Otis T. Mason has studied the traps of the American Indians.

The Scientific American Automobile and Yachting Number.

Next week's issue of the SCIENTIFIC AMERICAN will be another enlarged special number, this time devoted to automobiles and yachts. The cup defender is accurately described and illustrated; the new racing ratings of the New York Yacht Club are explained; and the New York Yacht Club itself and its handsome club house are described and pictured. Automobiles in warfare and the leading types of American and French vehicles form the subject of some interesting articles in the automobile section.

THE ADVANTAGES OF IN-TURNING SCREWS ON WARSHIPS.

Of late years there has been considerable discussion in naval circles upon the question as to whether it is more advantageous to have the screws of twin-screw vessels turn, as regards the movement of the top blades, inward toward the vessel, or outward from it. All of the present battleships of the United States navy have outward-turning screws, that is to say, during the upper half of the revolution of the blades they are moving away from the longitudinal axis of the ship. As a result of this arrangement, our ships have shown excellent maneuvering power—a fact which has forced itself on the attention of English naval officers, who mention the fact that during the last West Indian cruise their own battleships with inward-turning screws were inferior in maneuvering ability to our own. It is a curious fact that this inferiority appeared to be noticeable only when the vessels were maneuvering from a state of rest. Naval Constructor Taylor has prepared a diagram, a copy of which we are enabled by the courtesy of the Chief Constructor of the Navy to reproduce herewith, which shows that there is a decided advantage in outward-turning screws in enabling a vessel to turn more rapidly when she starts from rest.

It is known that as ordinarily fitted, the effect of a screw working when the vessel has not steerage way is to throw the stern transversely in the direction in which the upper blades of the screw are moving. This is because the upper blade does not get so good a grip on the water, and the transverse motion of the water, acted on by the upper blades, is more obstructed by the ship than that of the water acted on by the lower blades. In line with this theory, the arrows within the screw circles in the diagrams show the direction of revolution of the screws. The solid arrows above and below the screw circles indicate the transverse forces acting on the ship, the upper blades in each case, in Fig. 1, pulling the stern to starboard, and, in Fig. 2, pulling it to port; the lower blades pulling the stern to port in Fig. 1, and to starboard in Fig. 2. The net result is a transverse force $F_2 + F_4 - F_1 - F_3$, which pulls the stern to port in Fig. 1 and to starboard in Fig. 2. The result of the thrusts on the screws is a force tending to pull the stern to starboard both in Fig. 1 and in Fig. 2. The final resultant then of the transverse forces and thrusts developed by the screws is in Fig. 1 the difference of two forces, and necessarily less than either, while in Fig. 2 it is the sum of two forces, and necessarily greater than either.

If the propeller shafts, as they proceed aft from the engine, diverge, each upper blade meets the water at a smaller angle in Fig. 1 and at a greater angle in Fig. 2 than it would if the shafts were parallel; while each lower blade meets the water at a greater angle in Fig. 1 and at a smaller angle in Fig. 2. The dotted arrows outside the circles indicate the resulting changes in the transverse forces, and it is evident that the transverse forces acting against the screw thrusts are, in Fig. 1, strengthened; while the transverse forces acting to help the screw thrusts are, in Fig. 2, weakened.

The conclusions to be drawn from the above are: First, that in-turning screws reduce or nullify entirely the maneuvering powers under engines alone of twin-screw ships, when they have no steerage way. Secondly, that shafts diverging from the engines are inferior as regards maneuvering to parallel shafts, and shafts converging from the engines are superior in this respect to parallel shafts.

"Narragansett"—the Largest of Tank Ships.

From the Scott yards at Greenock, Scotland, the largest oil-carrying ship afloat has been launched. The vessel is to have a gross tonnage of 11,000 and a carrying capacity of 12,500 tons of oil. She will engage in the transatlantic trade for the Anglo-American Oil Company. Besides being the largest of oil-carrying vessels, the "Narragansett," as the ship has been christened, is the biggest steamship ever built in the lower reaches of the Clyde. Her length is 531 feet, her breadth 63.6 feet, her draft 42 feet. Fully loaded, her displacement will be 21,000 tons. She is built with eight athwartship bulkheads. The compartments thus formed are in turn subdivided by longitudinal bulkheads, with the result that there are in all seventy-two separate compartments below the main deck. Each one of these compartments will be oil-tight.

A most noteworthy departure in the design of the vessel is to be observed in the placing of the engines. In most oil tank steamers the engines are located in the stern. In the "Narragansett," however, the engines will be situated amidships.

There are sixteen main oil tanks, eight of which are located forward, and eight aft of the engine room. Between the upper and main decks are four smaller oil compartments, which are to be utilized when the vessel is loaded down to her summer freeboard.

The ship will be equipped with four Snow oil pumps, whereby it is possible to discharge oil at the rate of 900 tons an hour.

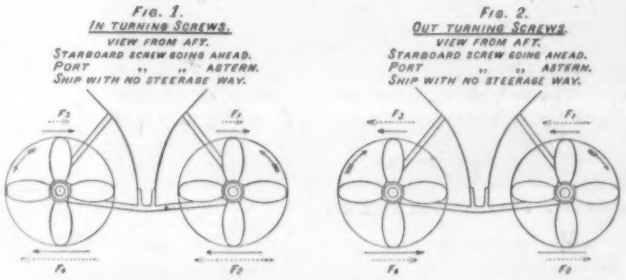


DIAGRAM SHOWING RELATIVE EFFECTS OF IN-TURNING AND OUT-TURNING SCREWS.

Pupin and Jentsch on Trans-Oceanic Telephony.

Dr. Jentsch, of the German telegraph service, recently criticised Prof. Michael Pupin's system of long-distance telephony. His objections were leveled, not at the electrical features of the system, but simply to certain mechanical difficulties that might be encountered. In his opinion, external pressure of the water would increase with the depth to which a submarine cable was laid. At a depth of two or three miles it would not be impossible that a pressure of 3,000 pounds to the square inch would be found. From this Dr. Jentsch concluded that the inductance coils of Pupin, unless constructed with extraordinary strength, would be crushed in. Dr. Jentsch, however, as well as Prof. Pupin himself, agrees that the difficulty is by no means insurmountable.

It has also been said that transatlantic telephony will not pay. Prof. Pupin is himself of that opinion, not because of any inherent fault in his system, but because of the customs of the business world. A transatlantic telephone system would be used chiefly during the business day of six or seven hours. Since the day begins in London and Paris five hours earlier than it does in New York, it follows that only during a period of one or two hours would the line be in use. Prof. Pupin's system, however, is equally adapted to the improvement of the submarine telegraph cable, so that its practical utility is by no means as curtailed as it might seem.

Further Curie Experiments With Radium.

Prof. Curie has announced to the French Academy of Sciences that radium possesses the extraordinary property of continuously emitting heat without combustion, without chemical change of any kind, and without any change in its molecular structure. Radium, he states, maintains its own temperature at a point 1.5 deg. Centigrade above the surrounding atmosphere. In other words, the quantity of heat evolved is such that a pure radium salt will melt more than its own weight of ice every hour, and half a pound of a salt of radium will evolve in one hour heat equal to that generated by burning one-third of a cubic foot of hydrogen gas. Despite this constant activity, the salt apparently remains just as potent as it was at the beginning.

News From the British Antarctic Expedition—A New Record.

Last July, the British wooden steamer "Morning" sailed from England to relieve the "Discovery," which left England in 1901, for the Antarctic zone. The "Morning" arrived at Auckland, New Zealand, March 25, and reports that the "Discovery" has been in winter quarters at Victoria Land since February last year. The "Discovery" entered the ice pack December 23, 1901, in latitude 67. On January 9, 1902, she reached Cape Dare, where she was detained by ice and storms. A party was, however, sent ashore on January 20 at Wood Bay, latitude 76 deg. 30 min., to deposit a record of the voyage. Two days later Cape Crozier was reached. On February 3 the "Discovery" entered an inlet in the barrier in longitude 174 deg. Here a balloon ascension was made. An exploring party in sledges examined the country to latitude 78 deg. 50 min. On March 24 the ship was frozen in; but the expedition passed a comfortable winter near Mounts Erebus and Terror. The lowest temperature recorded was 62 deg. below zero. On September 2 two sledge parties were sent out. One party under Royds and Skelton made a record expedition to Mount Terror, traveling over a barrier under severe sleighing conditions with the temperature 58 deg. below zero. But the best record made was that of Capt. Scott, Dr. Wilson, and Lieut. Shackelton. These intrepid explorers traveled 94 miles to the south, reaching land in latitude 80 deg. 7 min., longitude 136 deg. This is the most southerly point yet attained. The expedition proved a most severe test of the endurance of both men and animals. All the dogs died, so that several men had to drag the sledges back. Lieut. Shackelton almost died from exposure. The best previous records were those made by Sir James Ross (78 deg. 4 min.) and Borchgrevinck (78 deg. 50 min.)

From the news brought by the "Morning," it would seem that the "Discovery" expedition has gathered much valuable information. The ice barrier probably is a floating mass, which is fed by land ice. In latitude 82 deg. mountains two miles high were discovered. It is probable that the coast line continues at least as far as 83 deg. 20 min. due south. A rich collection of marine fauna forms not the least valuable part of the scientific work of the expedition.

Volcanic Dust Falls in Georgia.

On the evening of March 17 a shower of volcanic dust fell in the city of Athens, Ga. All over the yards and walks, and gardens there could be seen a yellow deposit which was very evidently of a sulphurous nature—in fact, it was almost pure sulphur. Along the gutters on the streets the rain had washed it in considerable quantities, and in some places it was found floating upon the surface of water where the water had collected in little puddles.

Large numbers of citizens gathered at places where the dust had accumulated and discussed the phenomenon. All practically agreed that the dust was probably from some volcanic eruption in Central America and had been wafted to this section on some breeze from that direction. It was undoubtedly sulphurous and no other explanation could account for its presence.

It developed during the day that the shower of sulphur was not confined to Athens, but was scattered throughout this section of the State.

The Selden Patent and the Automobile Trust.

The Selden patent, which was discussed in the SCIENTIFIC AMERICAN for November 24, 1900, and which, if sustained by the United States courts, may have a depressing influence on the automobile industry of this country, has been indirectly acquired by the recently formed automobile trust. The Electric Vehicle Company, by whom the Selden patent was purchased in 1900, is one of this trust, the members of which have pledged themselves not to prosecute one another for infringement of patents, but to submit their claims to a special board of their own appointment. Automobile makers, not members of the trust, should the Selden patent be upheld, will suffer.

The Selden patent for a hydrocarbon "road engine" was applied for on May 8, 1879. By skillful maneuvering and by filing his amendments just as the statutory time limit was about to expire, the inventor succeeded in delaying the issuing of his patent until November, 1895, when automobiles began to make their appearance. The claims cover about every essential element of a gasoline vehicle.

A New Star.

It is announced that a new star has been discovered by Mme. Ceraski, of Moscow. The star (Algol variable 41,903) proves to be an object of unusual interest. The Carnegie grant has enabled an examination of the photographs, taken with the Draper telescopes, to be made. This has shown that the star has a period of 1.3574 days = 1 d. 8 h. 34.7 m. and range of 2.4 magnitudes. About half an hour before minimum, the rate of diminution in light amounts to between two and three magnitudes an hour, and is probably greater than that of any other star yet discovered. A minimum was predicted here, and was observed photographically and photometrically, 1903, March, 19 d. 16 h. 24 m. G. M. T.

Harvard University. EDWARD C. PICKERING.

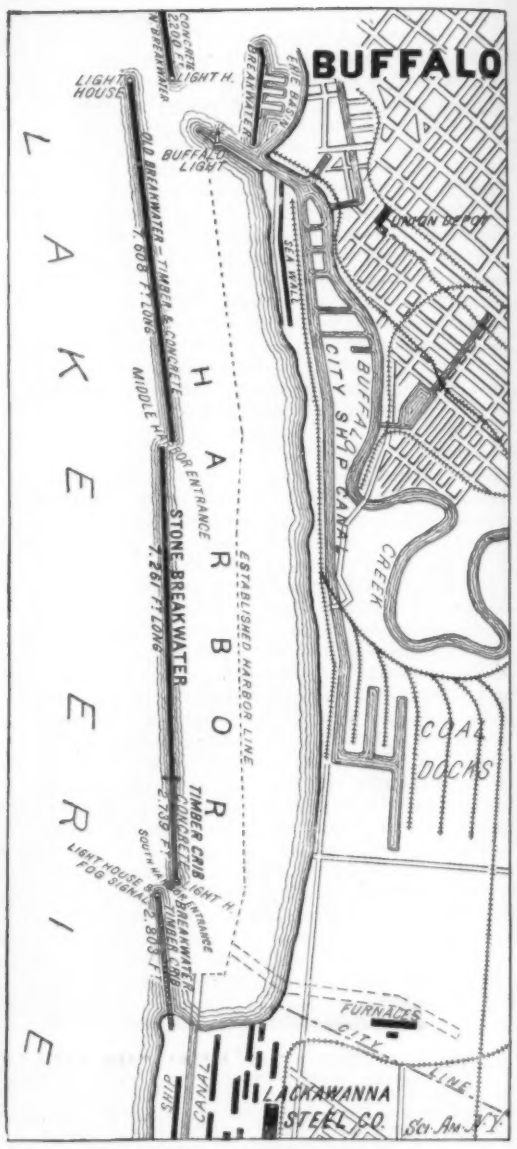
A third subsidiary barrage upon the Nile—the Zifta Dam—which is midway between Cairo and the sea, and forms a complement to those at Aswan and Asyut, has been opened. This latest work, although not to be compared with the other two Titanic erections, is yet an important section of the general irrigation project of Egypt. The Zifta barrage is only 1,224 feet in length and contains fifty arches each 16 feet broad. There is also a navigation lock 184 feet long and 40 feet wide. This barrage has been built at a cost of $2,250,000.

J. C. Whitlock, of Terre Haute, Ind., an employe of the Vandalia line, is the inventor of a method of avoiding the jolting which is usually experienced when a train passes over an intersection of tracks. He has designed a crossing which has some movable parts, which make a solid connection for the train to pass over. The device is being tried in the Vandalia line, and if entirely successful will be adopted.

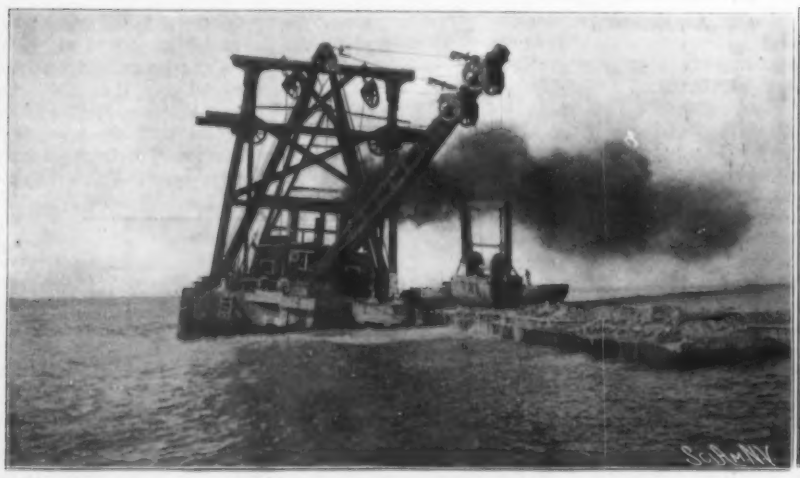
Original Crib Superstructure in Foreground; Concrete Reconstruction in Distance.

Finishing Off Stone Breakwater with Heavy Top Angle Stones.

The Completed Concrete Breakwater. Stony Point in Distance.



General Plan of Buffalo Breakwater.



Dredging the Trench 70 Feet Below Water Level.

Bird's Eye View of Stony Point Timber-crib Breakwater.

Building Concrete Structure Above the Timber-crib Foundation.

Trainload of Large Capping Stone, Ready for Shipment to the Breakwater.

THE NEW BUFFALO HARBOR BREAKWATER.

THE NEW BUFFALO HARBOR BREAKWATER.

There has recently been completed at Buffalo a new stone breakwater, which forms the most important section of a long line of breakwaters that extend for 4½ miles to form the artificial harbor of Buffalo. The work just completed has been carried out under the charge of, and according to the designs of, Major T. W. Symons, whose long experience in similar classes of work in connection with river and harbor improvement has been used to excellent effect in the, in many respects, novel and unprecedented work just completed at Buffalo.

At the time that the present work was undertaken there existed the north breakwater, which is built of concrete and extends for 2,200 feet, with a light at its southerly end. Opposite this light and to the westward of it is the northerly end of what is known as the old breakwater, a timber and concrete structure which extends for 7,608 feet. There is a light at the northerly end of the old breakwater, with a harbor entrance between it and the southerly light of the north breakwater. To the south of the old breakwater is the new structure of which we are treating. It consists of a stone breakwater 7,261 feet in length, which connects with a timber and concrete structure that extends southerly for another 2,739 feet, with a light at its southerly extremity. Parallel with the previous structure, and slightly to the westward of it, is a timber crib breakwater 2,803 feet long, which runs northerly from Stony Point. It has a light on its northern extremity, and the opening between this and the last-named breakwater forms the south harbor entrance, the opening between the stone breakwater and the old breakwater being known as the middle harbor entrance. The 7,261-foot stretch of the new breakwater is of the rubble mound type, stone-topped, while the southerly end of it, 2,739 feet, is built of timber crib construction, to enable vessels to moor alongside of it inside of the harbor. The work was done by Messrs. Hughes Brothers & Bangs, of Syracuse.

Fig. 2.—PHOTOGRAPH OF A FLEA MADE WITH THE CRYSTALLINE LENS OF A BULLOCK'S EYE

Fig. 3.—PHOTOGRAPH OF A FLEA MADE WITH THE USUAL LENS.

The new breakwater is built in the open waters of Lake Erie, parallel with the shore, 1,500 feet out from the pierhead line of the harbor, and in 30 feet of water. The first operation was to deposit two parallel ridges of small rubble on the lake bottom, one on the lake side and one on the shore side of the proposed breakwater, the intervening space being filled in with gravel. Another five feet of rubble ridges were added and again filled in with gravel, the mound thus formed being raised to within 10 feet of the surface of the water. The breakwater was then built up for the remaining 10 feet to the surface of the lake by dumping upon it large rubble stones. The slopes of the structure were covered with a revetment of large stones, which were lowered into place in close touch with each other, so as to completely cover the rubble stone, the object of these heavy quarried stones being to prevent displacement of the rubble by the action of the water. Then came the important work of covering the mound with large capping stones, which were quarried to prescribed dimensions, many of the stones measuring as much as 6 feet in thickness. These stones were carried out by five large floating derricks, each with a lifting power of 20 tons. The capping stones were laid snugly together, the finished top and side of the breakwater presenting a fairly even and true appearance. The photograph shows very clearly the way in which the top of the breakwater is finished, the heavy top angle stones serving by their weight and friction to prevent the heavy seas from taking hold of the rubble mound, loosening it and washing it away. A cross section of the breakwater as thus constructed shows it to be normally about 140 feet wide at the bottom and 14 feet wide at the top.

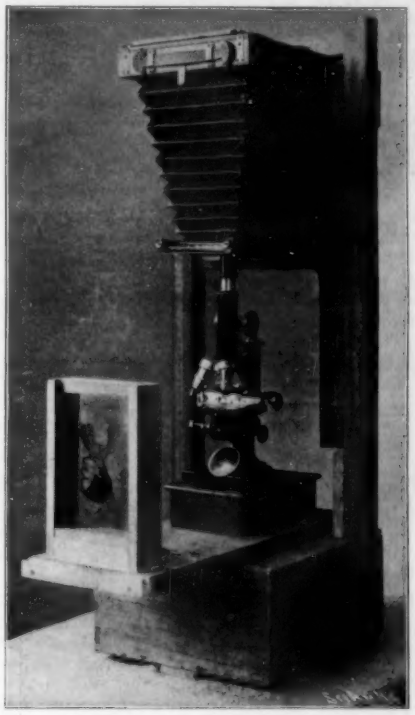


Fig. 1.—APPARATUS FOR MULTIPLE IMAGE PHOTOGRAPHY WITH THE LENS OF A BEETLE'S EYE.

While the masonry breakwater was being constructed, the work of building the timber-crib structure was also going on apace. As compared with the rubble mound type, the timber and concrete form has the advantage of being cheaper in construction. In building it the first step was to prepare a foundation and for this purpose a powerful clam-shell dredge built especially for the work was used to dredge a trench along the line of the breakwater in the bottom of the lake 95 feet in width, and 50 feet in depth through the clay. Then through the center of this trench another excavation was dredged out which was 50 feet in width and extended everywhere to solid rock. The next task was to fill in the trench thus formed with gravel which was brought to the spot in scows and dumped in, a bed of gravel, 30 to 40 feet in depth being formed in this way. Upon this was placed an embankment of rubble stone, 8 feet in height, which formed a foundation for the timber cribs. These cribs were built of sawn timber and were 36 feet in width, 22 feet in height and from 60 to 180 feet in length. They were towed to position over the foundation and sunk by loading with stone. The superstructure was built in three benches, the first 6 feet, the second 10 feet, and the third 12 feet above the mean water level of the lake. Each bench was 12 feet in width.

As shown in our illustrations, a certain portion of the crib breakwater, as finished, is of this construction; but the larger portion of it has been capped with concrete. This was done to strengthen the structure, the heavy gales of September 12 and November 21, 1900, in the latter of which the wind reached a velocity of 80 miles an hour, having loosened up and broken the above-water timber coping and finish. In repairing the ravages of the storm, the damaged superstructure was removed and the cribs were cut down to an elevation of 2 feet below the mean lake level. Upon this, concrete blocks, forming longitudinal and cross walls, were placed, and the pockets thus formed filled in with rubble stone, and roofed in with heavy concrete work, which was carried up to the level of the original breakwater. In place of the three benches of the crib superstructure, the reconstructed portion shows a parapet and a banquette. The parapet which is exposed to the lake side covers a width of 27 feet and its crest is 12 feet above mean lake level. The banquette is 8 feet in width and is uniformly 4 feet above the lake level. The new breakwaters have taken some six or seven years to construct, and the cost has been $2,200,000.

Our thanks are due to Major T. W. Symons for the illustrations and particulars in the above description of this important work.

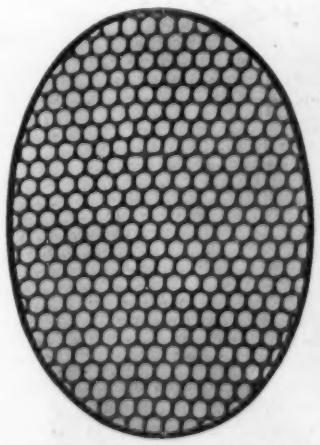


Fig. 5.—PORTION OF THE EYE LENSES OF A BEETLE, USED IN MAKING THE MULTIPLE-IMAGE PICTURE SHOWN IN Fig. 6.

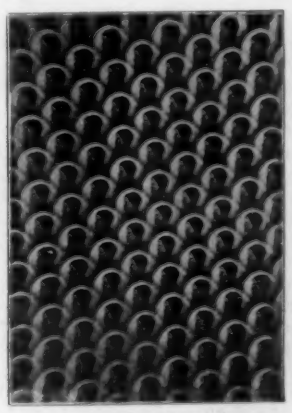


Fig. 6.—PART OF A MULTIPLE-IMAGE PICTURE MADE WITH THE LENS OF A BEETLE'S EYE.

PHOTOGRAPHIC EXPERIMENT WITH NATURE'S LENSES.

BY PROF. W. F. WATSON.

The eyes of animals possess various devices for the refraction of light and the formation of images upon the retina. The crystalline lens and the cornea appear to be the most important of these devices. When first removed from a large eye, as that of a bullock, the crystalline lens is a beautiful, clear, double-convex lens, about three-quarters of an inch in diameter. But it is quite soft and delicate, and must be handled with great care to prevent its being injured. Fig. 8 shows a crystalline lens which has just been removed from an eye and transferred to a round opening at the center of a square of pasteboard. It is covered with a bell-jar to protect from dust. Figs. 2 and 4 show the results of experiments which were made in attempting to produce photographs by using this natural lens in the camera in place of the ordinary camera lens. The method of making the photograph of the flea shown in Fig. 2 may be described as follows:

Fig. 4.—PHOTOGRAPH OF A WASP MADE WITH THE CRYSTALLINE LENS OF A BULLOCK'S EYE.

In the center of a pasteboard square a round hole is cut for the reception of the lens. This square is supported in a horizontal position by a wire frame. Its central opening must be less than three-quarters of an inch in diameter, so that the lens will be supported in it but will not drop through. The hole may be cut evenly in the pasteboard either on a microscopist's turntable or with a cork-borer of suitable size. Considerable skill is required in dissecting the eye without injury to the delicate lens, and also in transferring the lens, which must be done with a camel's-hair brush which has been dipped in aqueous humor. The lens is next

incased as shown in the upper sectional drawing of Fig. 7. To accomplish this, a small pasteboard pill-box (such as used in drug stores) is quite convenient. With a cork-borer one hole is made in the bottom and another in the top piece. The hole in the shallower piece, which is to go below the lens, should be about double the diameter of the other. These holes will serve as diaphragms. The pill-box parts are cemented to the pasteboard square, inclosing the lens, the shallower part below and the deeper part above, as shown in the lower sectional drawing of Fig. 7. The lower and shallower part should be cemented on the pasteboard square before the lens is placed in position. The camera must be supported pointing directly downward with its lens removed. While in this position the pasteboard bearing the natural lens is carefully inserted in the instrument and the surrounding parts made light tight. All of these manipulations must be accomplished without inverting the natural lens or turning it upon edge, on account of its liability to injury. The object is focused in the usual way and the picture taken by transmitted light. This method was used in producing the imperfect picture shown in Fig. 2. The negative and photograph have not been retouched or changed in any way, as the intention is to show exactly what the natural lens will do under these conditions. Beside it, in Fig. 3, is shown for comparison a photomicrograph of the same object made in the usual way by combining the microscope and camera. The imperfections in the picture produced in Fig. 2 are caused by minute irregularities in the surface of the natural lens. When first removed from the eye, the surface of the lens is very perfect. But upon exposure to air it immediately begins to dry, and thus minute irregularities develop upon its surface. If the surfaces of this lens could be kept moistened, as the cornea of the living eye is kept moistened by the eyelid, very perfect photographs could be made with it. It seems not only possible, but even probable, that if sufficient experimentation could be made on this lens, a method could be found for hardening it, without destroying its original shape and transparency. Experiments so far made, having this object in view, have not been successful. The liquids which were used as hardeners all made the lens either opaque or opalescent. In fact, this lens is very sensitive to the action of liquids in general. In making these experiments, about the only liquid which could be found which did not impair the lens in some degree was aqueous humor.

Good photographic results can be obtained from the crystalline lens by protecting its surfaces from evaporation by thin glasses of suitable curvature. The photograph of the wasp, Fig. 4, was made with the natural lens in this way. Two thin watch-glasses, or crystals, were selected and their inner surfaces moistened with aqueous humor. The crystals, it should be remarked, are more convex than those ordinarily used in watches, and are commonly used in chemical laboratories. The crystalline lens was taken from the eye and immediately transferred to these glasses, being inclosed by them like a clam within its shells. (See Fig. 7.) The edges of the watch-glasses were then sealed together with black, gummed paper. In fact, both of the outside glass surfaces were covered with black paper except a small, round diaphragm opening in the paper at the center of the convex surface of each watch-glass. A lens prepared in this way can be conveniently mounted in a camera in lieu of the ordinary camera lens. It is especially useful for photographing objects which are too small for the common camera lens and yet too large for ordinary photomicrography. The watch-glasses used with the natural lens should be accurate in curvature and free from flaws. Fig. 4 was made, like ordinary photographs, by reflected light. As this lens is of short focus, and must be brought very close to the object, the taste and skill of the experimenter are severely tested in the matter of securing proper illumination of the object for this kind of work.

The corneal lenses of an insect's eye, being very minute, are about as difficult to use in photography as the lenses just described. Possibly the images which they produce are just as perfect as those formed by any lenses, for it is known that the most minute natural objects frequently show the most marvelous perfection. But the difficulties encountered in magnifying and photographing the tiny images produced by these lenses are considerable. The eyes of a single beetle (in some species) have as many as 25,000 lenses, and each lens produces a separate image of the object. There will therefore be as many separate images as there are lenses. Though a large number of images can be photographed with these lenses at one exposure, this number is small in comparison with the number of images produced by the lenses.

The multiple-image picture, Fig. 6, was made by using the corneal lenses of the eye of a beetle. The photograph of a portion of the eye itself is shown in Fig. 5.

The apparatus for making multiple-image photographs is shown in Fig. 1, and the method of procedure may be described as follows:

Prepare a negative of the person whose picture is to be made. This negative is made in the usual way except that it should show very strong contrasts. From this negative prepare a positive by contact in a printing frame, in the manner of making a lantern slide. Support the positive (inverted) squarely in front of the sub-stage mirror of the microscope. Remove the Abbe condenser and adjust the mirror at an angle of 45 degrees. Place upon the microscope stage such an insect eye cornea as will best show multiple images, having previously mounted it as flat as possible with the cover-glass pressed down close to the slip. At first, focus the instrument upon the small lenses, then rack the objective backward from the object. If adjustments are right, the multiple images will now come into view. Open the iris diaphragm a little larger than it is intended to show in the picture, and adjust the sub-stage mirror so as to center the small image in each facet of the cornea. Connect with the camera bellows and place the apparatus in front of a south-view window, where no tree branches throw shadows into the room. Stand the apparatus facing the sun exactly, as any slight inclination to the right or left affects the lighting of the picture unfavorably. The strong sunlight falling upon the positive is modified by placing a plate of ground glass just in front of it. The groove shown in the base just in front of the frame holding the positive plate, in Fig. 1, is for the reception of the ground-glass plate. All extraneous light, not needed for making the picture, should be excluded as far as possible. The multiple images may now be focused upon the ground-glass of the camera. This must be done with great accuracy if good results are obtained. In using the high power lenses it should not be forgotten that the focus of the actinic rays does not exactly coincide with the focus of the light rays. Hence after obtaining the best possible focus on the ground glass with the fine adjustment, the screw should be turned slightly so as to move the objective an infinitesimal distance forward, toward the object. The exposure is made in the usual manner for photomicrographs. The time of exposure depends mainly upon the strength of the light and the degree of magnification of the lenses used. The time of exposure is about one minute and a half.

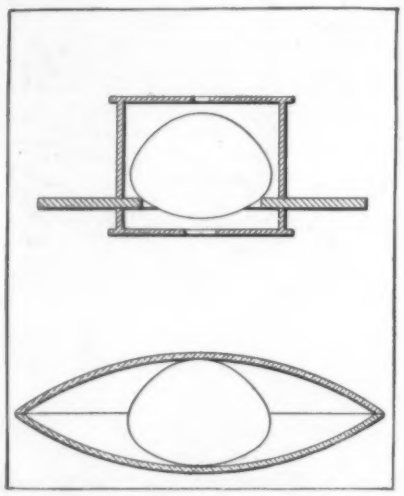


Fig. 7.—HOW THE LENS OF A BULLOCK'S EYE IS MOUNTED FOR PHOTOGRAPHING.

Fig. 8.—CRYSTALLINE LENS OF A BULLOCK'S EYE UNDER A BELL-JAR.

In the development of all plates for multiple-image pictures it is essential to work for a considerable contrast. Ordinary strength developers are quite unsatisfactory for these experiments, as they do not produce sufficient contrast. The best developing agent for this kind of work appears to be hydroquinone.

Discovery of the Tomb of Thothmes IV.

An American archæologist, Theodore M. Davies, has made one of the most interesting archæological discoveries of recent years in the ruins of ancient Egypt. Mr. Davies has succeeded in excavating the tomb of one of the Pharaohs of the eighteenth dynasty, Thothmes IV. In this tomb was found the chariot in which Thothmes rode at Thebes. Mr. Davies himself was not present when the actual discovery was made, that good fortune being left to Mr. Howard Carter, an Egyptian government officer.

Like the other royal tombs in the same valley, Thothmes' tomb consists of a gallery cut in the heart of the mountain.

After sloping downward for a considerable distance it is interrupted by a deep square well, on one of the walls of which is a band of paintings. On the further side of the well the passage turns back, and finally opens into a large chamber, at the extreme end of which is a magnificent sarcophagus of granite covered with texts from "The Book of the Dead."

On either side are smaller chambers, the floor of one of which was found by Mr. Carter to be covered with mummified loins of beef, legs of mutton, and trussed ducks and geese, offerings made to the dead king. Clay seals with the name of the Pharaoh had been attached to the doors of the chambers, and, it is stated, these seals contain proof that the Egyptians of between 3,000 and 4,000 years ago had to some extent anticipated the invention of printing, the raised portions of the seals having been smeared with blue ink before being pressed on the clay.

As Egyptologists know, there could be little hope of finding a mummy in the tomb, since the mummy of Thothmes IV. is already in the Cairo Museum, having been found in the tomb of Amen-hotep II., to which place it had been carried by the priests for the purpose of concealment, probably at some time in the twenty-first dynasty. A great many of the objects in the tomb of Thothmes were found to be broken, and this was explained by a hieroglyphic inscription on one of the paintings which adorn the walls of the vestibule to the chamber in which the sarcophagus was found. This inscription states that the tomb was plundered by robbers, but that it had been restored as far as possible to its original condition by Hor-em-heb, the reigning Pharaoh.

The floor was literally covered with vases, dishes, symbols of life, and other objects of blue faience. Unfortunately, nearly all of them had been wantonly broken, though in some cases the breakage had been repaired in the time of Hor-em-heb. Equally interesting is a piece of textile fabric into which hieroglyphic characters of different colors have been woven with such wonderful skill as to present the appearance of painting on linen.

It is, however, of course the Pharaoh's chariot which is regarded as the great find. The body of it alone is preserved, but in a perfect condition. The wooden frame was first covered with papier mache made from papyrus, and this again with stucco, which had been carved, both inside and out, into scenes from the battles fought by the Pharaoh in Syria. The art is of a very high order, every detail being exquisitely finished and the faces of the Syrians being clearly portraits taken from captives at Thebes. The chariot is, in fact, one of the finest specimens of art that have come down to us from antiquity. Along with the chariot was found the leather gauntlet with which the king protected his hand and wrist when using the bow or reins.

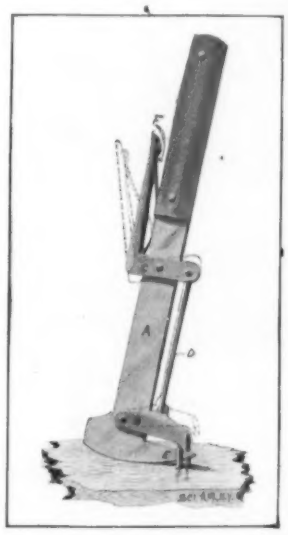
Next Week's Special Automobile and Yachting Number.

With the "fitting out" season for yachtsmen at hand, and with the country roads drying up after the winter's snow, ready for the automobile tourist, next week's large special number of the Scientific American, devoted to automobiles and yachts, comes most opportunely. The number contains just the kind of information wanted by the yachtsman, the automobilist and the public. In its pages will be found a full description of the "Reliance," together with her sheer plan, midship section, and details of her construction; an explanation of the new rating rules of the New York Yacht Club; and an illustrated account of the New York Yacht Club and its magnificent clubhouse. In the automobile section of the number, motor vehicles of all types for all uses are described. An article on automobiles in warfare tells much that is interesting of South African experiences; a full description and many pictures of the gasoline locomobile, the gasoline Columbia, the Cadillac, and other American and French machines will be found of value. Industrial vehicles are represented by motor trucks and an automobile log-conveying sled.

Patent Department

STAPLE PULLER.

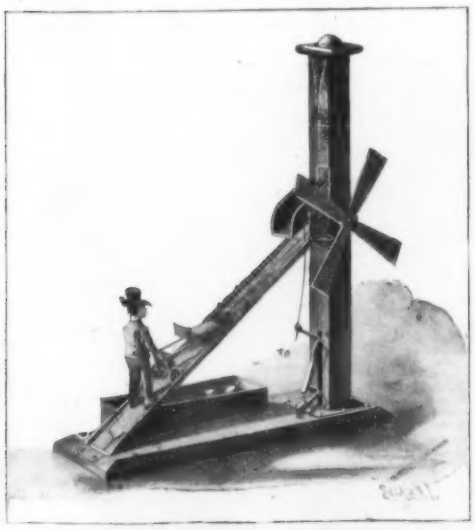
The accompanying illustration shows a simple form of staple puller which is capable of drawing straight out the longest fence-wire staples and of retaining the drawn staples until purposely removed from the device. This prevents the loss of staples when drawn out, and since they are not bent out of shape, they may be conveniently reused, if desired. The tool is the invention of Mr. George P. Haley, of Mexico, Mo. It consists, as illustrated, of a shank, *A*, provided with a handle at one end and a clawhead, *E*, at the other end. The clawhead has a hammer section at one end, and is pointed at the opposite or claw end. The under surface of the claw is curved, so as to form proper leverage for pulling out the longest staples in use for fence wire. A clamp *B* is used in conjunction with the claw. This consists of a U-shaped piece pivoted to the shank, and having teeth adapted to close over the sides of the claw. The clamp *B* is connected by a rod, *D*, to a bell crank, *C*, and is normally held out of engagement with the claw by a spring on the gripping end of the crank. In operation the claw is introduced beneath the bow-section of the staple, and driven well in by striking the hammer section of the claw head. At the same time the gripping section of the bell crank, *C*, is carried up close to the handle, bringing the teeth of the crank over and at each side of the point of the clawhead. The shank is then rocked upon the convex surface of the clawhead, and the staple is withdrawn. The clamp holds the staple upon the clawhead as long as the grip section of the lever is parallel with the handle of the device.



IMPROVED STAPLE PULLER.

AUTOMATIC TOY.

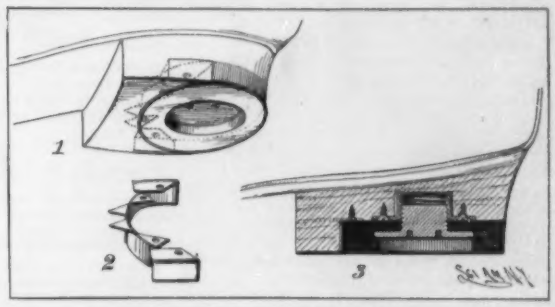
A very ingenious mechanical toy has been invented by Messrs. R. H. and R. D. Adams, of 3126 Fourth Avenue, South, Minneapolis, Minn. It represents an old windmill and a quaint little miller who is busily engaged in running up and down a chute, trundling a wheelbarrow which he uses in unloading the contents of the mill tower. Normally, the wheelbarrow remains at the top of the chute, being held in this position by a cord and counterweight suspended in the lower portion of the tower. The upper portion of the tower serves as a magazine for a number of spherical weights. These weights are prevented from rolling out through a hopper on to the chute by a trigger normally blocking the hopper. When the wheelbarrow is at the top of the chute, the counterweight depresses the lever which withdraws the trigger and permits a weight to roll out on to the wheelbarrow. This weight being heavier than the counterweight causes the wheelbarrow and the miller to travel down the chute, at the bottom of which a trip is encountered, which tilts the wheelbarrow sideways and rolls off the load into a receptacle. In the meantime the rest of the weights in the magazine are prevented, by a stop pin, from entering the hopper until the counterweight has been drawn to its highest position, when this pin is lifted, and the lowest weight is permitted to roll into the hopper against the trigger projecting therein, so that when the vehicle on being relieved of its load is drawn to the top of the chute again, this ball is ready to roll out on to it. The operations are thus repeated as long as the magazine is supplied with weights. The wind wheel shown serves as a governor to prevent the toy from operating too rapidly.



AUTOMATIC TOY.

SAFETY HEEL FOR FOOTWEAR.

The invention described below has been suggested by the increasing use of rubber treads on heels of shoes. These treads while having many advantages over the leather tread possess the serious drawback of giving a very treacherous foothold on icy and wet pavements. In order to overcome this difficulty Mr. Henry C. Karpenstein, of 155 Vernon Avenue, Brooklyn, N. Y., has designed a tread having an inverted cup-shape which will adhere by suction to the pavement. The method of fastening the tread in place is shown in the sectional view, Fig. 3. A circular recess is cut out of the heel body to receive the rubber tread. In the center of this recess a nut is let into the heel body. This is secured to the heel by screws passing through an annular flange on the nut. The tread is now held in place by the broad head of the screw which is tightly screwed into the nut as illustrated. In order to protect the corners of the heel body from injury, metal protectors, shown in Fig. 2, are secured thereto. Fig. 1 shows the position of these protectors on the heel and how they protect weak corners. Aside from insuring safety to the wearer by reason of the suction cavity in the rubber tread, this arrangement offers still another advantage, namely, that when one portion of the tread is worn down more than the other, it can readily be turned on its center to present a less worn surface to the side which receives the greatest wear. When the tread is completely worn out a new one may be quickly applied and secured by the retaining screw.

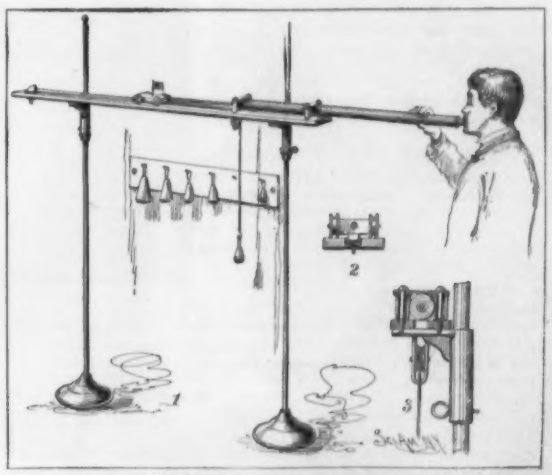


SAFETY HEEL FOR FOOTWEAR.

DIAPHRAGM METER AND EXERCISER.

Respiration depends chiefly upon the action of the diaphragm or the muscular organ intervening between the thorax and abdomen. The diaphragm descends into the abdominal cavity and compresses all the abdominal organs while the lungs are inhaling, and in expiration it mounts into the thoracic cavity in the form of a conical arch. Contraction of the diaphragm is auxiliary to the action of the muscular walls of the esophagus by which the cardiac opening of the stomach is regularly closed during inspiration. In the case of the greater majority of persons the lungs are usually inflated to but one-third their capacity and the stomach and abdominal organs are also agitated but slightly during respiration. The results are that the blood is not duly oxygenated, digestion and assimilation are imperfect, congestions of the lungs or abdominal organs are not duly relieved, and the tone of the nervous system is lowered, so that vulnerability to disorders or diseases of various kinds is greatly increased as compared with the normal standard.

These facts point to the usefulness of an apparatus invented by Dr. John E. Ruebsam, of Washington, D. C. This apparatus is adapted to test the strength of the diaphragm and also to exercise it, so as to avoid the results above stated. The apparatus proper is mounted upon two vertical standards and may be adjusted to any desired height. It consists of a track on which a small carriage is mounted to travel. A blow-tube is secured to one end of the track, and is provided with a piston, the rod of which projects from the tube and is secured to the forward end of the carriage. The carriage is normally held in its forward position by a weighted cord attached thereto and passing over a pulley at the forward end of the track. Various weights may be attached to the cord according to requirements. In using the apparatus a person blows through the pipe, and the carriage is moved backward a distance depending upon the strength of that person's diaphragm. By graduating the track in inches and fractions of the same, one can determine the progress of the patient from day to day in developing this organ.



DIAPHRAGM METER AND EXERCISER.

Women Inventors.

In the first year of the United States Patent Office's existence, 1790, a woman took out a patent. Up to the present time about 3,958 patents have been granted to women. Among the early women inventors may be mentioned Miss Mary Kies, who in 1809 perfected a device for weaving straw and thread. Three years later Miss Mary Brush designed a new corset, which she thought would preserve the shape of the womanly figure.

Like Miss Brush, many modern women inventors confine their inventiveness to the contriving of beautifying devices. Mrs. Batchelder, for example, has devised means for the improvement of certain facial features that have been distorted. Among her inventions may be mentioned an ear straightener which remedies imperfectly formed and lopping ears. Another invention for the restoration of facial symmetry is a spring attachment for the teeth, which relieves their severity and improves the mouth lines. Some women inventors, however, have devoted themselves to other things besides the perfection of womanly beauty. Mrs. Martha J. Coston, although not the first inventor of the signal lights of that name, has nevertheless made some important improvements in her husband's invention. Mrs. Cynthia W. Alden is the inventor of an improved dump cart. Some years ago Mrs. Lena Sittig devised a waterproof garment which has come to be known as the duckback. The ruled slate was devised by Mrs. Louise Dyer, of Yazoo City. An important attachment to the sewing machine was invented by Miss Helen Blanchard. Miss Philps, of Dorchester, Mass., is the inventor of the hand refrigerator and lunch box. Miss Emma D. Mills made an improvement on a typewriter for which it was necessary to construct special tools. She did the special construction herself. Mrs. Kate Eubank, of Oakland, Cal., has devised a combined trunk and bureau, which when closed appears as a Saratoga trunk and when open as a handsome dressing case.

There seems to be one professional woman inventor in America, and her name is Miss Montgomery. As far back as 1864 she took out a patent on an improved locomotive wheel. Later she secured a patent on an improved war vessel. A number of other patents have been issued to her, which have proved remunerative.

During the past year 1,520 locomotives were constructed at the Baldwin Locomotive Works in Philadelphia. This overtops all previous records at this plant. For the previous year the number was 1,375, and during the year 1900, the number of engines completed was 1,217. In the matter of tonnage the increase was much greater. Of the number built last year, 93 were sent abroad, the greatest number going to West Australia. The year's output was valued at $20,000,000.

RECENTLY PATENTED INVENTIONS.

Mechanical Devices.

WOOD-TURNING MACHINE.—L. D. BULLOCK, Pompanoosuc, Vt. This invention relates to improvements in machines for turning wood, the purpose being to provide a machine of simple construction by means of which spiral moldings or so-called "rope" and "cane" formed dowels may be rapidly produced.

BUTTON-TURNING MACHINE.—H. A. BERGER, Brooklyn, N. Y. A machine for turning mother-of-pearl buttons and the like is provided by this invention. It operates automatically to pass the button-blanks singly from a chute to a chuck, then the turning-tool is advanced to turn the face of the button-blank while the chuck revolves, after which the tool recedes and is sharpened, and finally the turned button is ejected from the chuck and replaced by a button blank.

WABBLE-SAW.—C. SEYMOUR, Defiance, Ohio. In bringing this device to perfection the inventor has provided a wabble-saw arranged to counteract the strain of the saw-blades on the arbor, to prevent undue vibration of the arbor, and to insure easy running of the saw and the formation of a smooth cut.

INTESTINE-CLEANER.—F. MATHEYER, New York, N. Y. The butchering industry gains an improvement in this intestine-cleaner which is very effective in operation, and arranged to thoroughly and quickly wash and lengthwise split open the intestines without requiring great skill of the operator.

CENTRIFUGAL SEPARATOR.—R. A. LUCAS and O. JEFFSON, Hilo, Hawaii. By employing centrifugal action for separating the impurities from sugar-cane juice, these inventors have produced a machine by means of which the impurities may be removed much more rapidly and economically than is possible with settling-tanks usually employed.

FALL-ROPE CARRIER AND OPERATING DEVICE THEREFOR.—A. LAMBERT and J. G. DELANEY, Newark, N. J. The inventors secure in this case, an improvement on fall-rope carriers of cable ways in which the fall-rope extends at both sides of the carriage. In the cableway it is desirable that the fall-rope have support at both sides of the carriage, and for this purpose a novel arrangement of carriers and a button-rope are provided therefor.

GLASS-BLOWING MACHINE.—J. SCHIES, Anderson, Ind. The main object of this improvement in apparatus for use in the manufacture of glass, is to connect the table supporting the pressing devices with the one sustaining the blowing devices, so the same may move in unison, and to provide power mechanism to operate the tables by power instead of by hand.

Railway Improvements.

RAILROAD-TIE.—F. H. ALFRED and P. CHIPMAN, Saginaw, Mich. This tie provides a substitute for wooden and all metallic ties now in use. The invention consists in combining concrete with metal to produce a tie in such manner that the tensile strains on it are mostly borne by the metal, while the compressive strains are taken up by the concrete to secure the greatest strength.

RAILROAD CROSS-TIE.—F. W. DUNNELL, Springfield, Mass. The aim in the present invention is to provide a cross-tie composed mainly of leather and stiffened by a metal core-bar. By provision of a plate-metal core-bar in combination with a composite tie-body a light, strong, slightly-resilient tie is produced, which, if made of waste leather for the tie-body will be inexpensive.

Miscellaneous.

HARP.—W. MOERSCHER, Belvidere, N. J. This instrument is similar to and played like the chromatic harp. The invention embodies a string-supporting frame and a co-operative arrangement therewith of a sounding-board, a sounding-damper, and a foot-controlled damper for regulating the tone effect. It is easily handled and will produce tone and resonance, similar to the piano.

ABDOMINAL SUPPORTER.—EVA M. TEMPLE, Portland, Ore. In producing this improvement the inventor secures a sanitary, simple, efficient, and easily adjusted bandage that can be worn at all times with very little discomfort. It will not interfere with or change the figure, it does not come in contact with the waist-line, and will not push up over the hips.

SAFETY-POCKET.—R. A. JAMES, Evansville, Ind. Mr. James has invented a wearing-apparel pocket. It consists of a peculiar safety-pocket more particularly intended for drawers, but which is adapted for and useful in connection with any article of clothing in which a pocket may be needed.

TOBACCO-PIPE.—A. W. THORNTON, McKeesport, Penn. In obtaining this improvement in tobacco-pipes the inventor supplies a simple and novel means for condensing or separating the moisture and nicotine from the smoke, thus preventing them from entering the smoker's mouth. The smoke will be practically cool and clean.

NOTE.—Copies of any of these patents will be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

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Marine Iron Works. Chicago. Catalogue free.

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AUTOS.—Duryea Power Co., Reading, Pa.

Inquiry No. 3987.—For makers of pile-driving outfits of all kinds.

For logging engines. J. S. Mundy, Newark, N. J.

Inquiry No. 3988.—For makers of small refrigerating machines for use in small dairy.

"U. S." Metal Polish. Indianapolis. Samples free.

Inquiry No. 3989.—For manufacturers of machinery used in a paper box factory.

Coin-operated machines, Willard, 284 Clarkson St., Brooklyn.

Inquiry No. 3990.—For makers of side rod galleries for gasoline gas, alcohol torches and galvanized iron expansion tanks.

Blowers and exhausters. Exeter Machine Works, Exeter, N. H.

Inquiry No. 3991.—For manufacturers of spring clasps for valises and sample cases.

Handle & Spoke Mchy. Ober Mfg. Co., 10 Bell St., Chagrin Falls, O.

Inquiry No. 3992.—For blue prints of one horse power stationary engines.

Sawmill machinery and outfits manufactured by the Lane Mfg. Co., Box 13, Montpelier, Vt.

Inquiry No. 3993.—For makers of underwear machinery.

PATENT FOR SALE.—A. L. & O. Sovelius' Twine Holder. Price, $6,000. Hancock, Mich.

Inquiry No. 3994.—For makers of graduating machines for graduating hardened steel scales.

FOR SALE.—60 h. p. Otto gas engine, the latest type, practically new. Colborne Mfg. Co., Chicago.

Inquiry No. 3995.—For the address of the Eclipse Flue Brush Mfg. Co.

Let me sell your patent. I have buyers waiting. Charles A. Scott, Granite Building, Rochester, N. Y.

Inquiry No. 3996.—For the address of the manufacturers of the Clayton disinfecting apparatus.

Automobiles built to drawings and special work done promptly. The Garvin Machine Co., 149 Varick, cor. Spring Streets, New York.

Inquiry No. 3997.—For manufacturers of boats of about 90 feet over all fitted with steam turbines.

Manufacturers of patent articles, dies, stamping tools, light machinery. Quadriga Manufacturing Company, 18 South Canal Street, Chicago.

Inquiry No. 3998.—For makers of seamless steel tubing of different sizes.

Crude oil burners for heating and cooking. Simple, efficient and cheap. Fully guaranteed. C. F. Jenkins Co., 1105 Harvard Street, Washington, D. C.

Inquiry No. 3999.—For manufacturers of flexible steel tubing.

The largest manufacturer in the world of merry-go-rounds, shooting galleries and hand organs. For prices and terms write to C. W. Parker, Abilene, Kan.

Inquiry No. 4000.—For manufacturers of balloons and parachutes.

The celebrated "Hornsby-Akroyd" Patent Safety Oil Engine is built by the De La Vergne Refrigerating Machine Company. Foot of East 138th Street, New York.

Inquiry No. 4001.—For makers of tin foil collapsible tubes.

The best book for electricians and beginners in electricity is "Experimental Science," by Geo. M. Hopkins. By mail, $5. Munn & Co., publishers, 361 Broadway, N. Y.

Inquiry No. 4002.—For makers of umbrella covers and handles for repair shop.

Parties wanted to manufacture and market latest improved copying press, on royalty basis. Child can exert a pressure of tons. Principle adaptable to presses of all kinds. H. W. Haff, Chappaqua, N. Y.

Inquiry No. 4003.—For a machine for paring and coring pineapples.

Manufacturers wanted to introduce on royalty a metallic strap grip for buckle attachment adapted for all light straps. Inventor will pay cost of all necessary dies. Address Snaffle, Box 773, New York.

Inquiry No. 4004.—For makers of water levels for leveling up machinery or other objects by a column of water.

Wanted—Revolutionary Documents, Autograph Letters, Journals, Prints, Washington Portraits, Early American Illustrated Magazines, Early Patents signed by Presidents of the United States. Valentine's Manuals of the early 40's. Correspondence solicited. Address C. A. M., Box 773, New York.

Inquiry No. 4005.—For makers of drying machines for use in manufacturing paper.

Will estimate on General Machine Work or Mfr. Pat. Articles on Royalty. Address Greenfield Steam Engine Works, East Newark, N. J.

Inquiry No. 4006.—For a pump for extracting mud from the bottom of cisterns.

WANTED.—Superintendent on heavy machinery. Shop located in large eastern seaboard city, and has up-to-date facilities, employing 500 hands. Work varies widely. Applicant must have broad experience, executive and mechanical ability and satisfactory references. To the right man permanent employment, and liberal salary. Address in confidence giving age, experience and salary. James Brady, Room J, 20th Floor, 22 Broadway, N. Y.

Inquiry No. 4007.—For machinery for extracting turpentine from refuse of yellow pine saw mills, such as sawdust, slabs, etc.

AN INTERNATIONAL EXHIBITION of machinery and implements for Dairy Industries is to be held at Palermo, in the city of Buenos Aires, Argentine Republic, from the 15th to the 23d of September, 1903, under the management of the Argentine Rural Society. American manufacturers are invited to concur with their exhibits. For further information and programmes please address B. A. de Toledo

Argentine Consul General
134 Produce Exchange, N. Y.

Inquiry No. 4008.—For manufacturers of building stone dressing machinery.

Inquiry No. 4009.—For skimming pans for cream separators.

Inquiry No. 4010.—For manufacturers of stove urns, also for parties engaged in stamping in sheet metal.

Inquiry No. 4011.—For machines for digging ditches and trenches 4 feet deep and not more than 18 inches in width.

Inquiry No. 4012.—For the manufacturers of the Twitchell Acidimeter for determining the acidity of wines and grape juice.

Inquiry No. 4013.—For makers of rough drop forgings used in the polishing and plating of dental forceps.

Inquiry No. 4014.—For makers of machinery for knitting mills, woolen mills, pearl buttons, etc.

Inquiry No. 4015.—For manufacturers of stable fittings.

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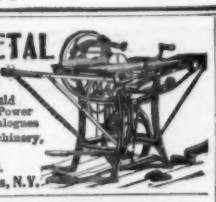

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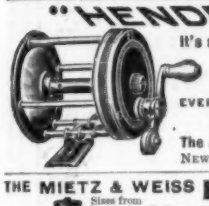

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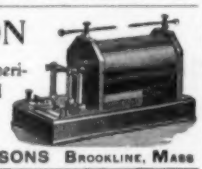

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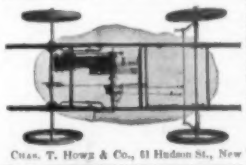

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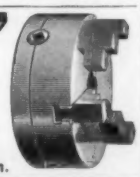

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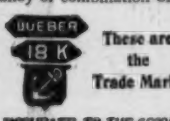

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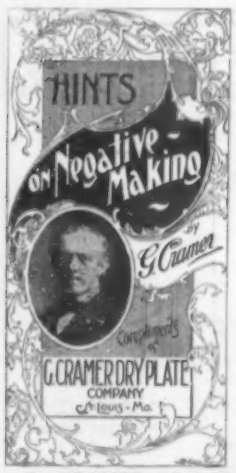

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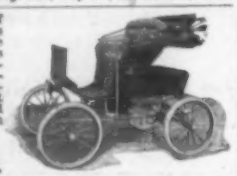

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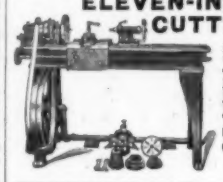

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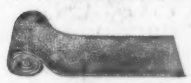

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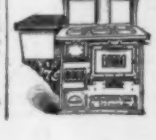

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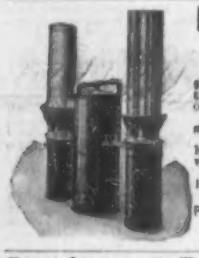

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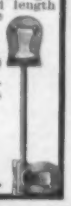

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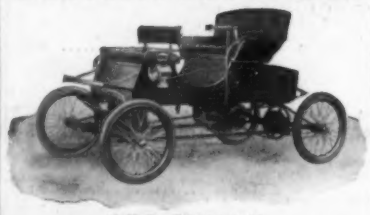

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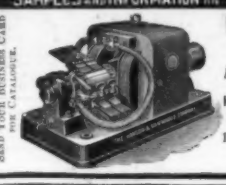

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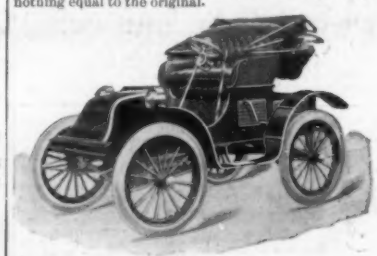

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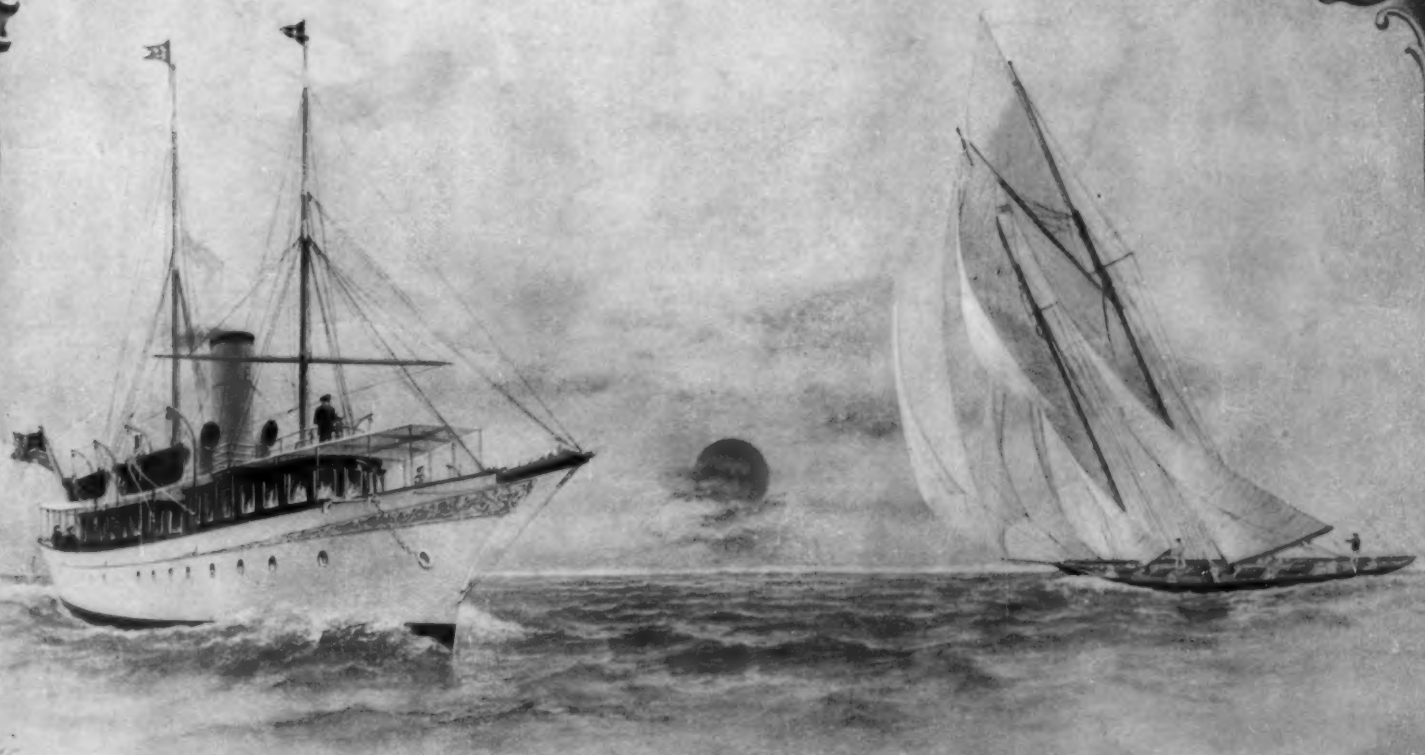

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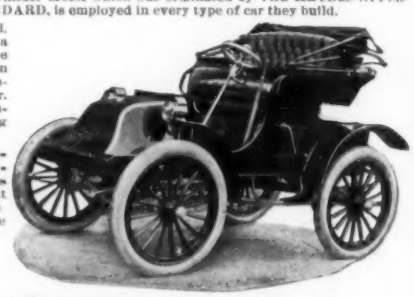

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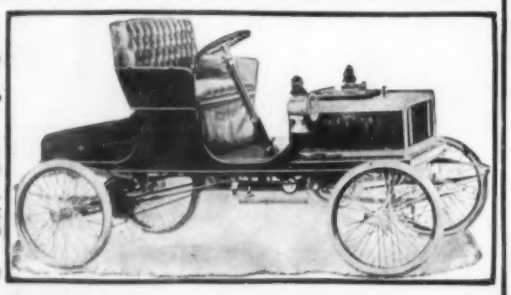

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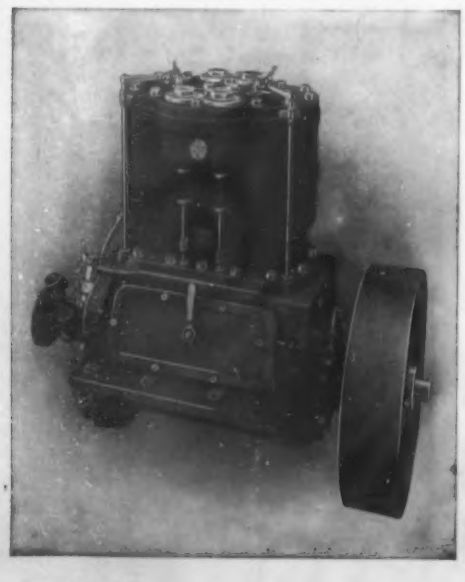

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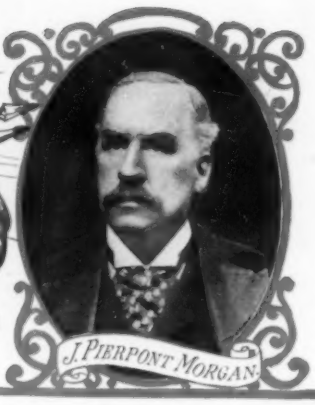

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